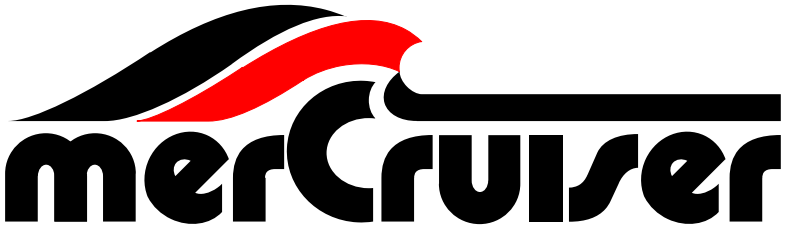

SERVICE MANUAL

Number 11

Bravo Sterndrives

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MerCruiser #11 Bravo Sterndrives

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MerCruiser #11 Bravo Sterndrives

90-17431--4

Notice

Throughout this publication “Warnings” and “Cautions” (accompanied by the International HAZARD symbol ⚠) are used to alert the mechanic to special instructions concerning a particular service or operation that may be hazardous if performed incorrectly or carelessly - OBSERVE THEM CAREFULLY! These “Safety Alerts” alone cannot eliminate the hazards that they signal. Strict compliance to these special instructions when performing the service, plus “common sense” operation, are major accident prevention measures.

⚠ WARNING

WARNING - Hazards or unsafe practices which COULD result in severe personal injury or death.

⚠ CAUTION

CAUTION - Hazards or unsafe practices which could result in minor personal injury or product or property damage.

IMPORTANT: Indicates information or instructions that are necessary for proper operation and/or maintenance.

Notice To Users of This Manual

This service manual has been written and published by the service department of the manufacturer to aid our dealers’ mechanics and company service personnel when servicing the product described herein. It is assumed that these personnel are familiar with the servicing procedures of this product, or like or similar products. That they have been trained in the recommended servicing procedures of these products which includes the use of mechanics’ common hand tools from other suppliers.

We could not possibly know of and advise the service trade of all conceivable procedures by which a service might be performed and of all possible hazards and/or results of each method. We have not undertaken any such wide evaluation. Therefore, anyone who uses a service procedure and/or tool which is not recommended by the manufacturer, first must completely satisfy himself that neither his nor the product’s safety will be endangered by the service procedure selected.

All information, illustrations, and specifications contained in this manual are based on the latest product information available at time of publication.

As required, revisions to this manual will be sent to all dealers contracted by us to sell and/or service these products.

Replacement Parts

⚠ WARNING

Electrical system components on gasoline engines and MerCruiser Sterndrives are designed and manufactured to comply with U.S. Coast Guard Rules and Regulations to minimize risks of fire or explosion.

Use of replacement electrical systems components, which do not comply to these rules and regulations, could result in a fire or explosion hazard and should be avoided.

When servicing electrical systems, it is extremely important that all components are properly installed and tightened. If not, any electrical component opening would permit sparks to ignite fuel vapors from fuel system leaks, if they exist or develop.

⚠ WARNING

Electrical system components on diesel engines are not external ignition protected. DO NOT STORE OR UTILIZE GASOLINE ON BOATS EQUIPPED WITH THESE ENGINES, UNLESS PROVISIONS HAVE BEEN MADE TO EXCLUDE GASOLINE VAPORS FROM ENGINE COMPARTMENT (ref: 33 CFR). Failure to comply could result in fire, explosion and/or severe personal injury.

Models Covered in This Manual

MODEL	SERIAL NUMBER
Bravo One Sterndrive Unit	B664190 and Above
Bravo Two Sterndrive Unit	B892613 and Above
Bravo Three Sterndrive Unit	D763691 and Above
Bravo Transom Assembly (Standard) *	B673048 and Above
Bravo Transom Assembly (High Performance)	D796083 and Above
Bravo Transom Assembly (Magnum)	K104738 and Above

* Some “Standard” Bravo Transom Assemblies could have been converted to “High Performance” Transom Assemblies by use of a High Performance Gimbal Ring Kit (822374A2). Refer to Transom Assembly sections of this manual for identification information.

NOTICE

Refer to appropriate engine service manual for engine repair.

Service Manual Outline

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- B - Maintenance
- C - Troubleshooting

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- A - All Models

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- B - Gear Housing - Bravo One
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- B - Trim Cylinders
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- D - Auto Trim II

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- A - All Models

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- A - All Models

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- A - All Models

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1 A

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How To Use This Manual

This Manual is divided into sections which represent major components and systems.

Some sections are further divided into parts which more fully describe the component.

Sections and parts are listed at front of this manual.

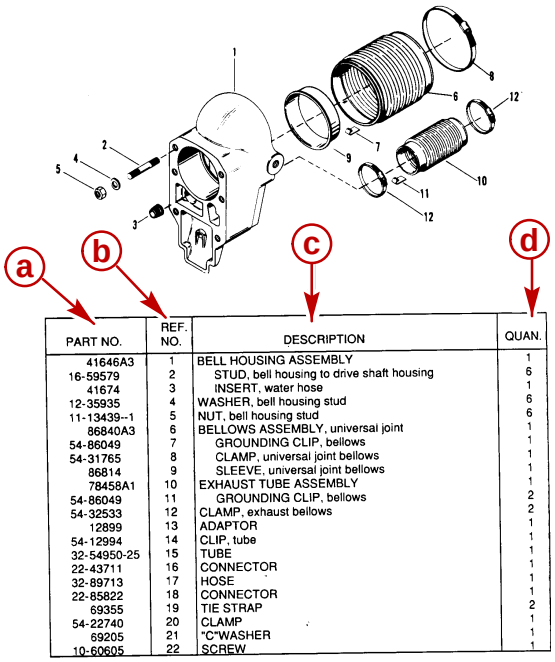
Page Numbering

Two number groups appear at the bottom of each page. Following is an example and description.

a - Section Number
b - Section Part
c - Page Number
d - Manual Part Number
e - Revision Number
f - Month Printed
g - Year Printed

How To Read Parts Manual

Bell Housing



PART NO.	REF. NO.	DESCRIPTION	QUAN.
41646A3	1	BELL HOUSING ASSEMBLY	1
16-59579	2	STUD, bell housing to drive shaft housing	6
41674	3	INSERT, water hose	1
12-35935	4	WASHER, bell housing stud	6
11-13439--1	5	NUT, bell housing stud	6
86840A3	6	BELLOWS ASSEMBLY, universal joint	1
54-86049	7	GROUNDING CLIP, bellows	1
54-31765	8	CLAMP, universal joint bellows	1
86814	9	SLEEVE, universal joint bellows	1
78458A1	10	EXHAUST TUBE ASSEMBLY	1
54-86049	11	GROUNDING CLIP, bellows	2
54-32533	12	CLAMP, exhaust bellows	2
12899	13	ADAPTOR	1
54-12994	14	CLIP, tube	1
32-54950-25	15	TUBE	1
22-43711	16	CONNECTOR	1
32-89713	17	HOSE	1
22-85822	18	CONNECTOR	1
69355	19	TIE STRAP	2
54-22740	20	CLAMP	1
69205	21	"C"WASHER	1
10-60605	22	SCREW	1

Part Number (a): part must be ordered by complete part number.

Reference Number (b): number of part on exploded parts view.

Description (c): this column provides important information.

(1.) Description of part: Reference 1, on the parts list, is a BELL HOUSING ASSEMBLY; reference 12 is an exhaust bellows clamp, and reference 19 is a TIE STRAP.

(2.) What parts are included: Reference 1, on the parts list, is “Bell Housing Assembly”. Parts listed under the assembly are indented, which indicates that they are included. So, if Part No. 41646A3 is ordered, you will receive the Bell Housing Assembly, including 6 studs, and one water hose insert.

(3.) Serial number break: If serial number is listed, check product serial number to ensure that correct part is ordered.

(4.) Special Information: Will often appear after the description, i.e.: “O-ring on DSH,” “O-ring on top cover,” “Casting #1641-8293C1,” etc. This information enables you to select correct parts.

Quantity (d): specifies quantity which must be ordered.

Special Information Block: provides additional information, part numbers for gasket sets, etc.

GEAR HOUSING
SEAL KIT
26-76868A1
INDICATED BY (*)

Access Hole Plug Kit 22-88847A1
Contains all necessary parts to allow removal of swivel shaft without removing gimbal housing.

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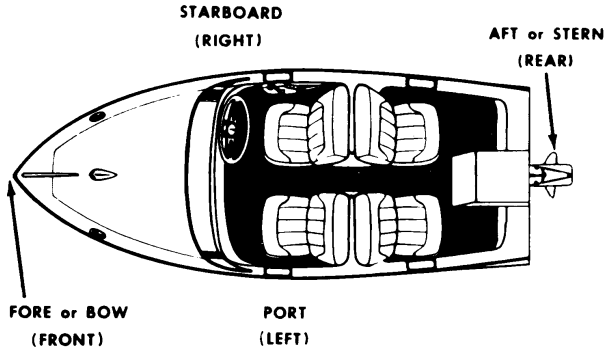
Introduction

This comprehensive overhaul and repair manual is designed as a service guide for the MerCruiser models previously listed. It provides specific information, including procedures for disassembly, inspection, assembly and adjustment, to enable dealers and service mechanics to repair these products.

Before attempting repairs, it is suggested that procedure first be read through to gain knowledge of the methods and tools used and the cautions and warnings required for safety.

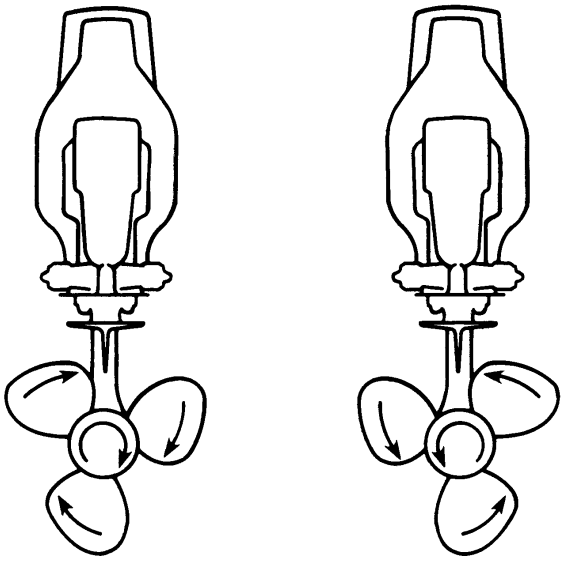
Directional References

Front of boat is bow; rear is stern. Starboard side is right side; port side is left side. In this service manual, all directional references are given as they appear when viewing boat from stern, looking toward bow.



Propeller Rotation

Propeller rotation for sterndrive can be right hand or left hand rotation as viewed from the aft end of the propeller.

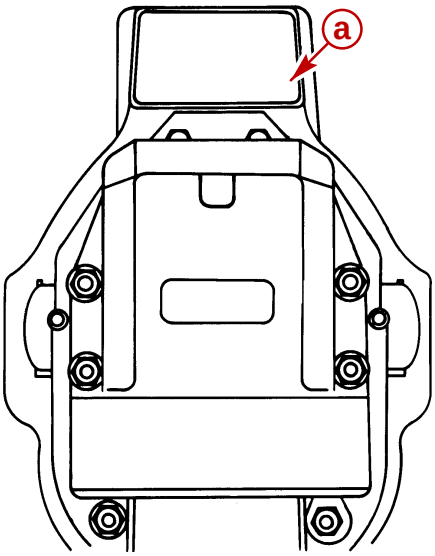


Right Hand Rotation **Left Hand Rotation**

Sterndrive Unit 10-Hour Break-In Period (New or With Replacement Gears)

1. Avoid full throttle starts.
2. DO NOT operate at any one constant speed for extended periods of time.
3. DO NOT exceed 75% of full throttle during the first 5 hours. During the next 5 hours, operate at intermittent full throttle.
4. Drive unit should be shifted into forward gear a minimum of 10 times during break-in, with run-in time at moderate RPM after each shift.

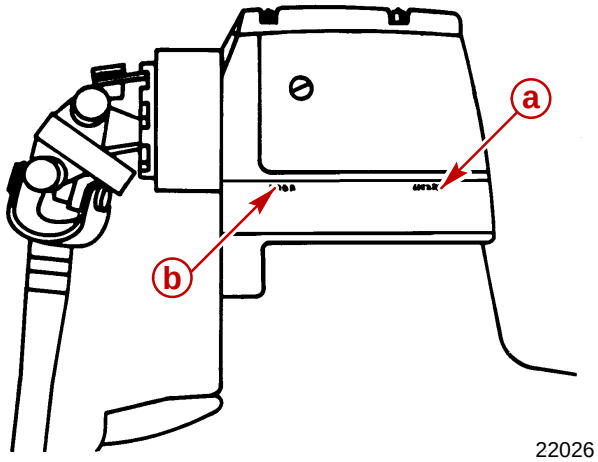
Serial Number Locations and Engine Designation Decal



22031

Transom Assembly Serial Number Location

a - Transom Assembly Serial Number



22026

Sterndrive Unit Serial Number Location - Port Side Decal

a - Sterndrive Unit Serial Number
b - Sterndrive Unit Gear Ratio

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GENERAL INFORMATION

Section 1B - Maintenance

1 B

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Maintenance Schedules

Maintenance Intervals

Maintenance intervals and the tasks to be performed, as shown in this current schedule, or as found in a previously printed schedules, are generally based on an average boating application and environment. However, individual operating habits and personal maintenance preferences can have an impact on the suggested intervals. In consideration of these factors, MerCruiser has adjusted some maintenance intervals and corresponding tasks to be performed. In some cases, this may allow for more individual tasks to be performed in a single visit to the serving dealer, rather than multiple visits. Therefore, it is very important that the boat owner and servicing dealer discuss the current Maintenance Schedule and develop appropriate maintenance intervals to coincide with the individual operating habits, environment, and maintenance requirements.

Scheduled Maintenance That Can Be Performed By Owner/Operator

NOTE: *Only perform maintenance which applies to your particular power package.*

Task	Interval
Engine Crankcase Oil - Check level	Weekly
Closed Cooling Coolant - Check level	
Power Steering Fluid - Check level	
Sterndrive Unit Oil - Check level	
Battery - Check level and inspect for damage	
Fuel Pump Sight Tube (If Equipped) - Check that no fuel is present	
Power Trim Pump Oil - Check level	
Anodes - Inspect for erosion	
Gear Housing Water Pickups - Check for marine growth or debris	
Drive Belt(s) - Inspect condition and check tension	Every 100 hours of operation or 120 days. whichever occurs first.
Propeller Shaft - Lubricate	**Saltwater Use**: Every 50 hours of operation or 60 days, whichever occurs first. **Freshwater Use:** Every 100 hours of operation or 120 days, whichever occurs first.
Power Package - Exterior Surfaces - Spray with rust preventative	
Power Package Exterior Surfaces - Clean and paint	Once a year
Cooling System - Flush seawater section	**Saltwater Use:** After every use.

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Scheduled Maintenance That Can Be Performed by Dealer

NOTE: *Only perform maintenance which applies to your particular power package.*

Task	Interval
Seawater Pickup Pump - Disassemble and inspect	Whenever insufficient seawater flow is suspected. (If operating temperature exceeds normal range.)
Crankcase Oil and Filter - Change	End of first boating season and thereafter, every 100 hours of operation or once yearly, whichever occurs first.
Ignition system - Clean and inspect condition	
Flame Arrestor and Crankcase Ventilation Hose - Clean and inspect	
Positive Crankcase Ventilation (PCV) Valve (If Equipped) - Change	
Sterndrive Unit Oil - Change	
Gimbal Ring Clamping Screws - Retorque to 40 ft. lb. (54 N·m)	
Rear Engine Mounts - Ensure torque is 30-40 ft. lb. (47-54 N·m)	
Gimbal Bearing - Lubricate	
Cooling System - Clean and inspect	
Engine Alignment - Check	
Engine Coupling Universal Joint Shaft Splines - Lubricate	
Steering System - Lubricate and inspect for loose, damaged or missing parts	
Electrical System - Check for loose or damaged wiring	
Cooling System Hoses and Clamps - Inspect for damage and deterioration. Check clamps for tightness.	
Closed Cooling System Pressure Cap - Clean, inspect and test	
Continuity Circuit - Check components for loose connections, broken or frayed wires	
Shift and Throttle Cable and Linkage - Lubricate and inspect for loose, damaged or missing parts	

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Scheduled Maintenance That Can Be Performed by Dealer (Continued)

NOTE: *Only perform maintenance which applies to your particular power package.*

Task	Interval
Engine Exhaust System - Inspect externally for damage, deterioration and restrictions. Check for tightness.	End of first boating season and thereafter, every 100 hours of operation or once yearly, whichever occurs first.
Ignition System - Check timing and adjust as needed	
Steering Head and Remote Control - Inspect and lubricate	
Carburetor (If Equipped) - Inspect and adjust	
Throttle Body (EFI Models) - Inspect	
Fuel Filters - Replace	Once a Year
Quicksilver Mercathode System - Test output	
Closed Cooling Coolant - Test for Alkalinity	
Heat Exchanger - Clean seawater section	
Drive Unit Bellows and Clamps - Inspect	
Universal Joint Cross Bearings- Inspect and grease	End of first boating season and thereafter, every 200 hours of operation or once yearly, whichever occurs first.
Closed Cooling Coolant - Replace	Every Five Years or 1,000 hours of operation[1]

[1]Only if Extended Life 5/100 Ethylene Glycol Antifreeze/Coolant is used. If any non-compatible coolant is added to this coolant, coolant must be changed every 2 years or 400 hours, whichever occurs first. All coolants other than Extended Life 5/100 Ethylene Glycol Antifreeze/Coolant must be changed every 2 years or 400 hours, whichever occurs first.

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Specifications

Torque Specification

Drive Unit Fill/Drain Plug	30-50 lb. in. (3.39-5.56 N·m)
Drive Unit Vent Plug	30-50 lb. in. (3.39-5.56 N·m)

Quicksilver Maintenance Products

We recommend the use of Quicksilver Maintenance Products where specified.

Fluid Capacities

NOTICE

UNIT OF MEASUREMENT: U.S. Fluid Ounces (Milliliters)
All capacities are approximate fluid measures.

MODEL	BRAVO ONE	BRAVO TWO	BRAVO THREE
Drive Unit Oil Capacity (With Square Gear Lube Monitor)	88 (2603)	104 (3076)	96 (2839)
Drive Unit Oil Capacity (With Round Gear Lube Monitor)	96 (2840)	112 (3313)	104 (3076)

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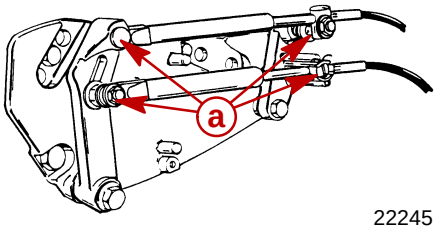
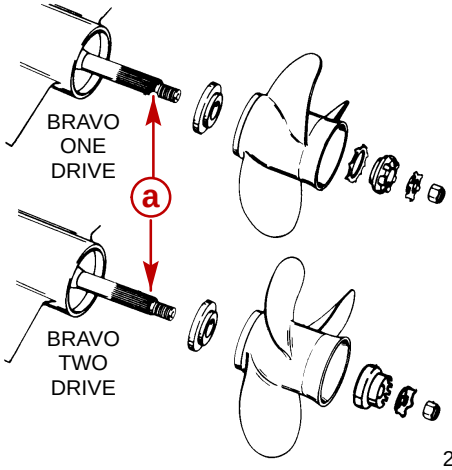
Lubricating Shift Cable Pivot Points



22245

a - Lubricate with SAE 20 or 30 Engine Oil

Lubricating Propeller Shaft



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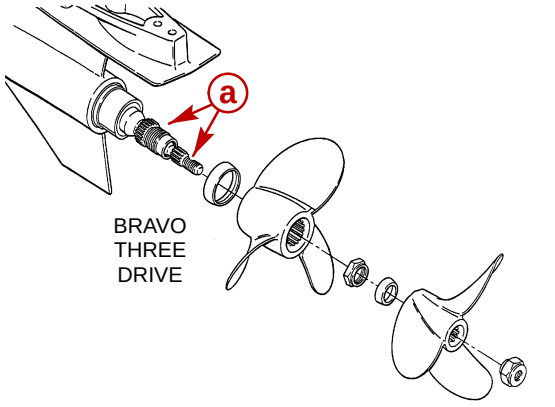


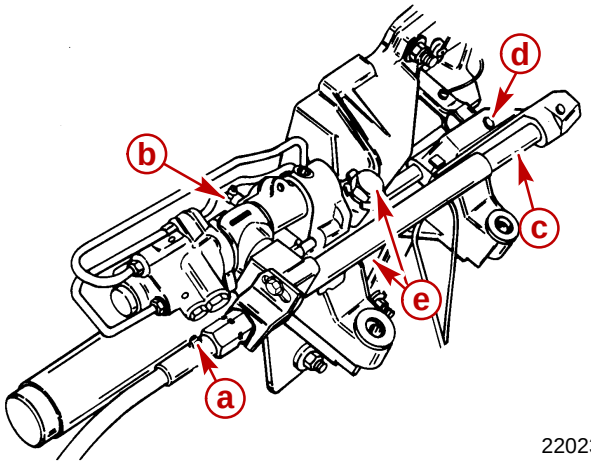
72239

a - Propeller Shaft - Lubricate with Special Lubricant 101, Anti-Corrosion Grease, 2-4-C Marine Lubricant with Teflon (Listed in Order of Effectiveness).

Lubricating Steering System

⚠ WARNING

Transom end of steering cable MUST BE fully retracted into cable housing when lubricating cable. If cable is lubricated while extended, hydraulic lock of cable could occur.



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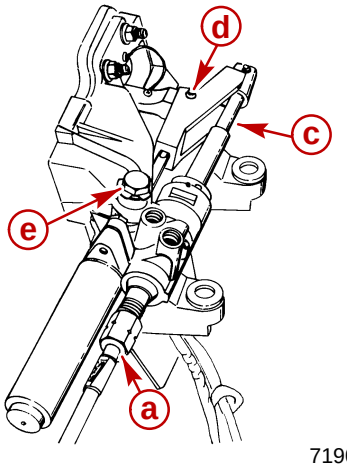

71901

Earlier Style Control Valve **Later Style Control Valve**

a - Steering Cable Grease Fitting - 2-4-C Marine Lubricant with Teflon (See Warning Above)
b - Control Valve Grease Fitting - 2-4-C Marine Lubricant with Teflon
c - Steering Cable End - Special Lubricant 101
d - Pivot Point - SAE 20 or 30 Engine Oil
e - Pivot Bolts - Special Lubricant 101

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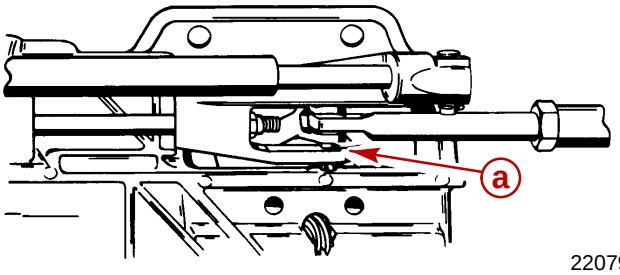
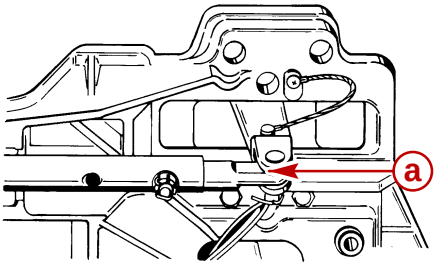
Lubricating Tie Bar Pivot Points

Models With Control Valve Mounted On Starboard Transom Assembly



22079

Starboard Engine



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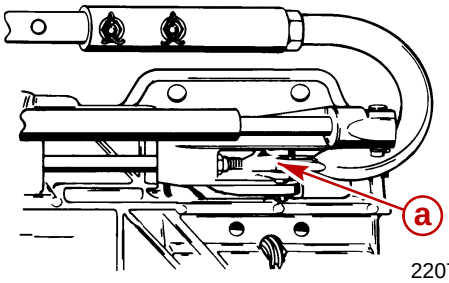
Port Engine

a - SAE 20 or 30 Engine Oil

Models With Control Valve Mounted On Port Transom Assembly



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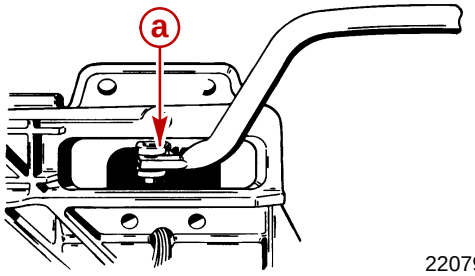
Port Engine

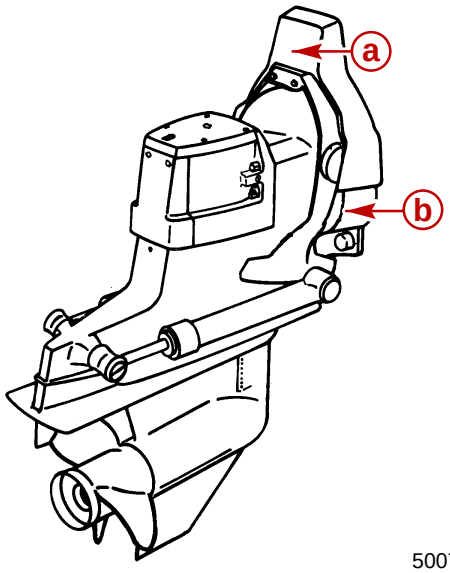


22079

Starboard Engine

a - SAE 20 or 30 Engine Oil

Lubricating Transom Gimbal Housing Assembly Swivel Shaft and Gimbal Bearing



50072

a - Swivel Shaft Grease Fitting - 2-4-C Marine Lubricant with Teflon (On Earlier Models)
b - Gimbal Bearing Grease Fitting - Quicksilver U-Joint and Gimbal Bearing Grease

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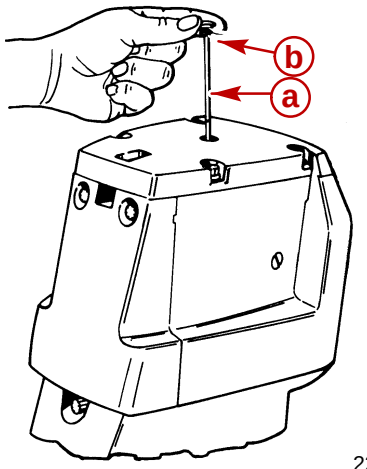
Checking and Adding Sterndrive Oil

IMPORTANT: Position sterndrive unit in DOWN/IN position so that anti-ventilation plate is level.

Models Without Drive Unit Gear Lube Monitor

1. Check oil level - oil should come up to line on dipstick. If oil is at proper level, reinstall oil dipstick and sealing washer. If oil is low, proceed to Step 2.



22098

a - Oil Dipstick
b - Sealing Washer (on Threads)

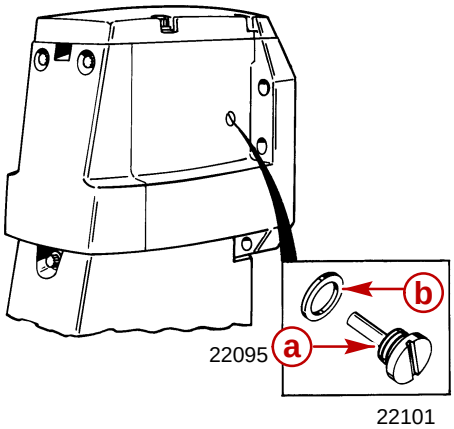
⚠ CAUTION

DO NOT attempt to fill drive unit through oil vent hole, as air will be trapped in drive unit and unit will be damaged from lack of lubrication.

⚠ CAUTION

If more than 2 fl. oz. (59 ml) of oil is required to fill drive unit, an oil leak may exist. Find and correct cause of leak before unit is placed in operation.

2. If oil level is low, reinstall dipstick; then, remove oil fill/drain plug and insert lubricant pump into oil fill/drain hole.
3. Remove oil vent plug; then, fill drive unit (through oil fill/drain unit hole) with oil until an air-free stream of oil flows out of oil vent hole.



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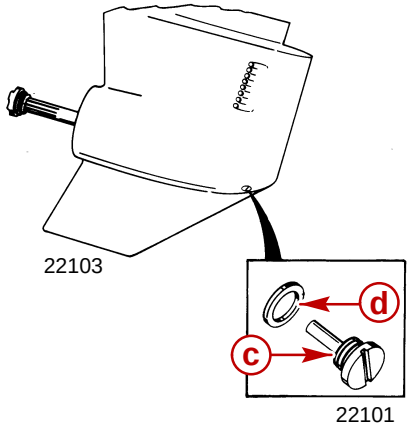

22103

22101

a - Oil Vent Plug
b - Sealing Washer or O-ring
c - Oil Fill/Drain Plug
d - Sealing Washer or O-ring

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4. Without removing lubricant pump from fill/drain hole, reinstall vent plug and sealing washer (or O-ring if equipped). Torque to 30-50 lb. in. (3.39-5.56 N·m).
5. Remove lubricant pump and quickly reinstall fill/drain plug and sealing washer (or O-ring if so equipped). Torque to 30-50 lb. in. (3.39-5.56 N·m).
6. Recheck oil level, using dipstick.

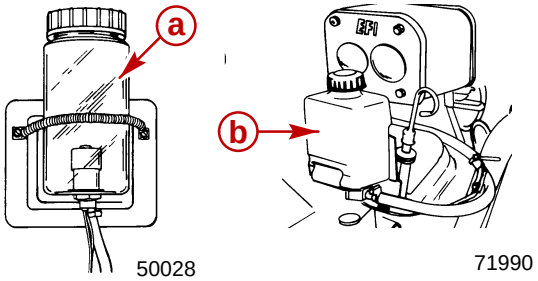
Models With Gear Lube Monitor

IMPORTANT: Position drive unit in DOWN/IN position so that anti-ventilation plate is level.

NOTE: *Drive unit oil level is checked at gear lube monitor.*

50323

IMPORTANT: Oil level in gear lube monitor will rise and fall during drive operation; always check oil level when drive is cool and engine is shut down.



50028 71990

a - Round Gear Lube Monitor
b - Square Gear Lube Monitor

1. Fill gear lube monitor to “FULL” line on decal. Lubricate O-ring seal on gear lube monitor neck with sterndrive oil, to ensure ease of installing and removing cap, and install gear lube monitor cap. Do not overtighten cap - 1/4 turn, after cap contacts seal, is sufficient.

⚠ CAUTION

On models with Gear Lube Monitor, that have a dipstick in driveshaft housing cover: DO NOT REMOVE DIPSTICK - DO NOT CHECK OIL LEVEL WITH DIPSTICK. Removal of dipstick results in oil level raising/overfill condition, which can cause oil seal damage; if left open, drive unit will overflow.

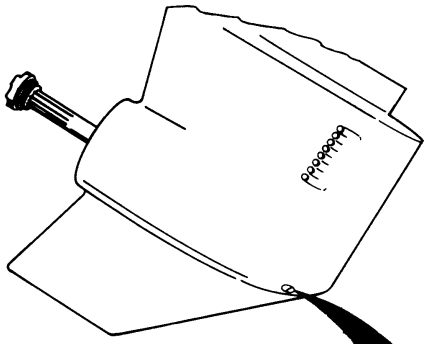
2. Check oil level in gear lube monitor.

Checking Lubricant for Water

Periodically inspect lubricant for water, to ensure that drive unit seals are not leaking.

MODELS WITHOUT DRIVE UNIT GEAR LUBE MONITOR

1. Trim drive unit to the full trim UP/OUT position. Remove fill/drain plug to take a sample of lubricant. If water is observed or if lubricant appears discolored, drive unit is leaking and must be resealed.



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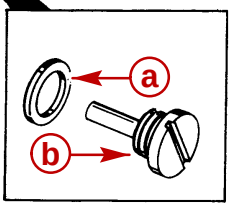


22101

a - Fill/Drain Plug
b - Sealing Washer or O-ring

2. Reinstall fill/drain plug. Torque to 30-50 lb. in. (3.39-5.56 N·m).

MODELS WITH GEAR LUBE MONITOR

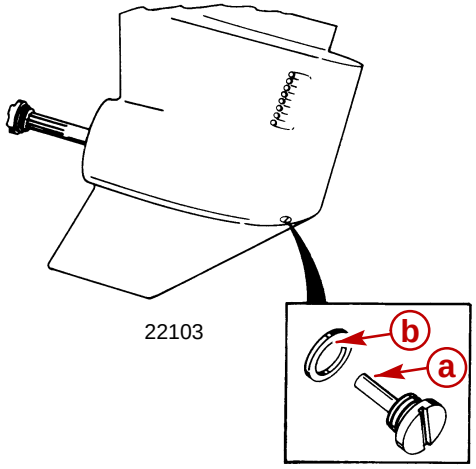
Check for water at bottom of gear lube monitor, and/or if oil appears discolored, a water leak is indicated somewhere in the drive unit, and drive unit must be resealed.

⚠ CAUTION

If more than 2 fl. oz. (59ml) of Quicksilver High Performance Gear Lube is required to fill gear lube monitor, a seal may be leaking. Find and correct cause of leak before unit is placed in operation.

IMPORTANT: If drive unit has set overnight or longer, check for water in drive unit, as follows:

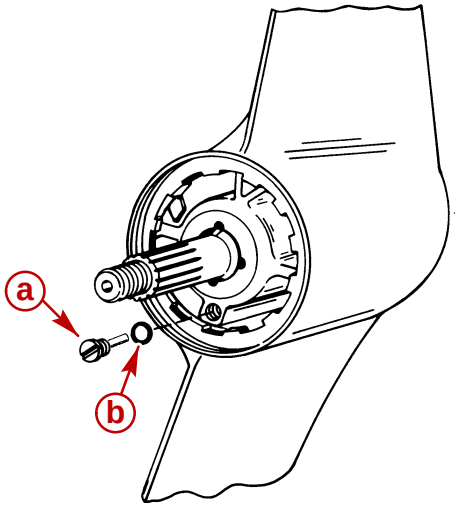
1. Trim drive unit to full UP/OUT position **if** drain plug is located in nose of gear housing.



22103 22101

a - Oil Fill/Drain Plug
b - Sealing Washer or O-ring

2. Trim drive unit to full DOWN/IN position, **if** drain plug is located in bearing carrier.



70023

a - Oil Fill/Drain Plug
b - Sealing Washer or O-ring

3. Remove fill/drain plug to sample lubricant. If water runs out, and/or if lubricant appears discolored, drive unit is leaking and **must** be resealed.
4. Reinstall fill/drain plug. Torque to 30-50 lb. in. (3.39-5.56 N·m).

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Changing Lubricant

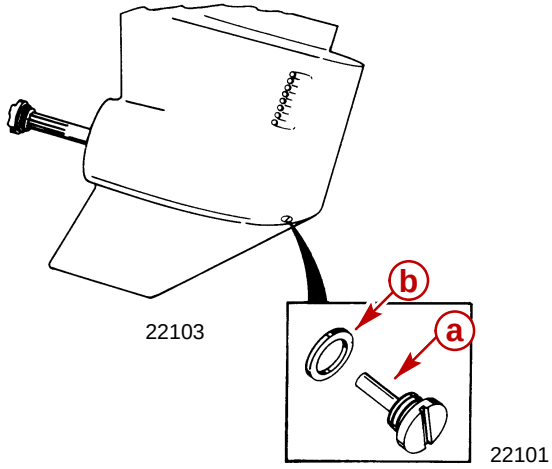
⚠ CAUTION

If any water drains from fill/drain hole, or if oil color appears discolored, a leak in drive unit may exist. Find and correct cause of leak before placing unit back in operatIon.

⚠ CAUTION

DO NOT attempt to fill drive unit through oil vent holes, as air will be trapped in drive unit and unit will be damaged from lack of lubrication.

1. Trim drive unit to full UP/OUT position **if** drain plug is located in nose of gear housing.

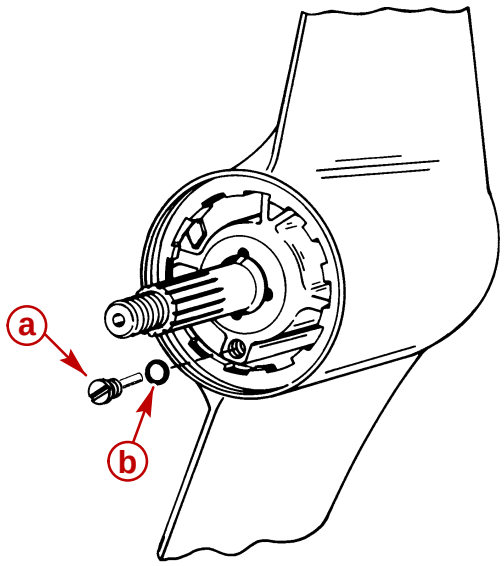


22103

22101

a - Oil Fill/Drain Plug
b - Sealing Washer or O-ring

2. Trim drive unit to full DOWN/IN position, **if** drain plug is located in bearing carrier.



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a - Oil Fill/Drain Plug
b - Sealing Washer or O-ring

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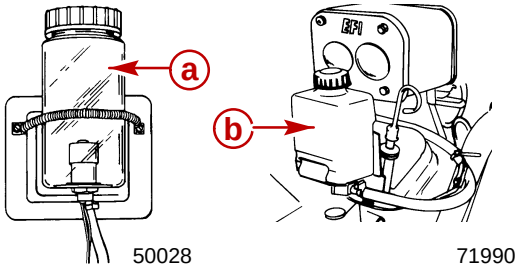
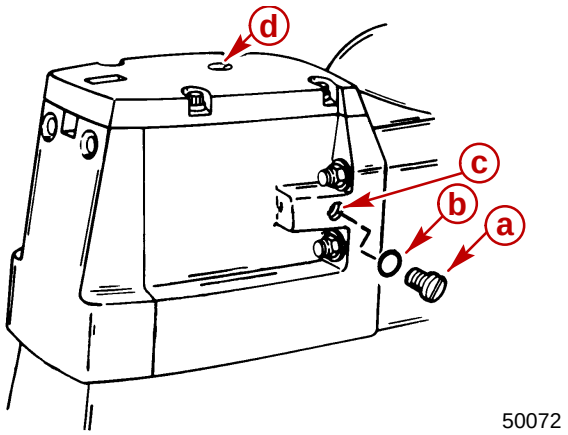
3. **Models with drive unit Gear Lube Monitor, only:** remove drive unit gear lube monitor from bracket, remove cap, empty contents of gear lube monitor into suitable container and discard. Clean gear lube monitor thoroughly, and return gear lube monitor to bracket. Do not refill at this time. Check condition of hose and hose connections - replace as necessary.



a - Round Gear Lube Monitor
b - Square Gear Lube Monitor

4. **All models:** remove drive unit vent plug, and fill/drain plug; allow lubricant to drain completely.
5. If drive unit is draining in full DOWN/IN position, trim to full UP/OUT position after draining, to further drain any remaining oil from internal driveshaft housing ledges.
6. Trim drive unit to full DOWN/IN position (with anti-ventilation plate level) to complete draining process.



a - Oil Vent Plug
b - Sealing Washer or O-ring
c - Vent Hole
d - Dipstick (if present, DO NOT OPEN or remove on oil Gear Lube Monitor models)

7. Using lubricant pump, fill drive unit through fill/drain hole with lubricant until oil is even with bottom edge of vent hole.
8. Without removing lubricant pump from fill/drain hole, reinstall oil vent plug and sealing washer.
   Non-Gear Lube Monitor models: torque oil vent plug to 30-50 lb. in. (3.39-5.56 N·m).
   Gear Lube Monitor Models: tighten oil vent plug snugly; do not torque at this time.
9. **All models:** remove lubricant pump and quickly reinstall fill/drain plug and sealing washer. Torque to 30-50 lb. in. (3.39-5.56 N·m).

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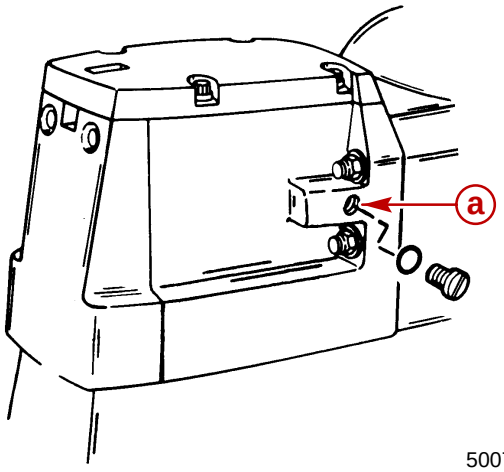
Models with Gear Lube Monitor, (steps 10-12):

10. Remove oil vent plug and sealing washer (with drive unit in full DOWN/IN position).
11. Fill gear lube monitor bottle with Quicksilver High-Performance Gear Lube. When oil starts to run out the vent hole (gear lube hose between drive unit and gear lube bottle becomes filled), reinsert vent plug. Torque to 30-50 lb. in. (3.39-5.56 N·m).
12. Fill gear lube monitor to “FULL” line on decal. Lubricate O-ring seal on gear lube monitor neck with sterndrive oil, to ensure ease of installing and removing cap. Install gear lube monitor cap. Do not overtighten.
13. **All models:** recheck oil level after first use.



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a - Vent Hole

General Maintenance

Maintaining Power Package Exterior Surfaces

Entire Power Package should be sprayed at recommended intervals with Quicksilver Corrosion Guard. Follow instructions on can for proper application.

At least once each year, entire Power Package should be cleaned and external surfaces that have become bare should be repainted with Quicksilver Primer and Spray Paint.

Steering Head and Remote Control Maintenance

Lubricate steering head and remote control with 2-4-C Marine Lubricant with Teflon. Inspect steering head and remote control for ease of operation.

Checking Quicksilver MerCathode System

If boat is equipped with a Quicksilver MerCathode System, system should be tested to ensure that it is providing adequate output to protect underwater metal parts on boat. Test should be made where boat is moored, using Quicksilver Reference Electrode and Test Meter. Refer to Section 7.

Maintaining Anodic Trim Tab or Plate

Each sterndrive unit is equipped with a sacrificial anodic trim tab (or plate on later models) to help protect underwater metal parts from galvanic corrosion. Because of its self-sacrificing nature, trim tab (or plate) MUST BE replaced if eroded 50% or more. An anodic plate is the new service replacement for the anodic trim tab. Install the anodic plate in place of the anodic trim tab. Refer to Section 7.

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Checking Optional Quicksilver Anti-Corrosion Anode Kit

If boat is equipped with Quicksilver Anti-Corrosion Anode Kit, inspect anode and replace if eroded to less than 50% of its original size. Carefully follow installation instructions, that accompany new Anode Kit, to ensure proper installation.

Boat Bottom Care

To achieve maximum performance and fuel economy, boat bottom MUST BE kept clean. Accumulation of marine growth or other foreign matter can greatly reduce boat speed and increase fuel consumption. To ensure best performance and efficiency, periodically clean boat bottom in accordance with manufacturer's recommendations.

In some areas, it may be advisable to paint the bottom to help prevent marine growth. Refer to the following information for special notes about the use of antifouling paints.

Antifouling Paint

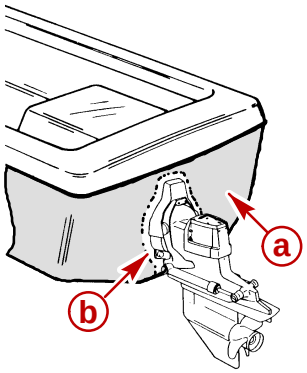
IMPORTANT: Corrosion damage that results from the improper application of antifouling paint will not be covered by the limited warranty.

Painting Boat Hull or Boat Transom: Antifouling paint may be applied to boat hull and boat transom but you must observe the following precautions:

IMPORTANT: DO NOT paint anodes or MerCathode System reference electrode and anode, as this will render them ineffective as galvanic corrosion inhibitors.

IMPORTANT: If antifouling protection is required for boat hull or boat transom, copper or tin base paints, if not prohibited by law, can be used. If using copper or tin based antifouling paints, observe the following:

- **Avoid an electrical interconnection between the MerCruiser Product, Anodic Blocks, or MerCathode System and the paint by allowing a minimum of 1-1/2 in. (40mm) UNPAINTED area on transom of the boat around these items.**



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a - Painted Boat Transom
b - Minimum 1-1/2 in (40mm) UNPAINTED Area Around Transom Assembly

NOTE: *Drive unit and transom assembly can be painted with a good quality marine paint or an antifouling paint that DOES NOT contain copper, tin, or any other material that could conduct electrical current. Do not paint drain holes, anodes, MerCathode system, and items specified by boat manufacturer.*

Maintaining Ground Circuit Continuity

The transom assembly and sterndrive unit are equipped with a ground wire circuit, to ensure good electrical continuity between engine, transom assembly and sterndrive components. Good continuity is essential for the MerCathode System to function effectively. Refer to Section 7.

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Power Package Layup (Out of Season Storage)

Engine

Refer to appropriate Engine Service Manual.

Sterndrive

1. Lubricate steering system. Refer to Section 6.
2. Lubricate transom gimbal housing assembly swivel shaft, gimbal bearing, and propeller shaft. Refer to Section 4 and Section 1-B.
3. Lubricate sterndrive unit U-joint shaft splines and cross bearings. Refer to Section 3-A.
4. Inspect U-joint bellows for cracks or other signs of deterioration. Check bellows clamps for tightness. Refer to Section 4.
5. Check engine alignment. Refer to Engine Service Manual.
6. Change sterndrive unit oil. Refer to Section 1-B.
7. Inspect sterndrive for damage. Repair or replace damaged components.
8. Clean sterndrive exterior surfaces and repaint any bare metal surfaces with Quicksilver Primer and Spray Paint. Refer to Section 1-B.
9. After paint has dried spray entire sterndrive with Quicksilver Corrosion Guard. Refer to Section 1-B.

⚠ CAUTION

Store sterndrive unit in the full trim DOWN/IN position. U-joint bellows may develop a “set” if unit is stored in raised position and may fail when unit is returned to service.

10. If not already done, place sterndrive unit in the full trim DOWN/IN position.
11. Store battery. Refer to battery manufacturer’s instructions.

Power Package Recommissioning

Engine

Refer to appropriate Engine Service Manual.

Sterndrive

1. Perform ALL maintenance specified for completion “At Least Once Each Year” in “Maintenance Chart” (Refer to Section 1-B), except items which were performed at the time of sterndrive layup.
2. Install fully-charged battery. Clean battery cable clamps and terminals and reconnect cables. Be sure to tighten clamps securely. Apply a thin coat of petroleum based grease to clamps and terminals to help retard corrosion.
3. After recommissioning and starting engine, check steering system and shift control for proper operation.

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GENERAL INFORMATION

Section 1C - Troubleshooting

1 C

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Troubleshooting

This section is a guide for performance and product troubleshooting. Referrals to specific sections of this manual are made where special tests or repair procedure are to be performed.

Because of the relationship between Power Package components (engine and sterndrive), it will be necessary, in some cases, to simultaneously refer to the appropriate Engine Service Manual for further troubleshooting information.

Effective troubleshooting is best enhanced by:

- Personal product knowledge and experience of the trained mechanic/technician.
- Allowing adequate time for testing and analysis.
- Utilizing these charts as a “guide” - a starting point.

Sterndrive Unit Troubleshooting

Sterndrive Unit Will Not Slide Into Bell Housing

Cause	Remedy
1. U-joint shaft splines not aligned with engine coupler splines.	1. Rotate propeller shaft COUNTERCLOCKWISE to align splines.
2. Engine not aligned.	2. Check engine alignment.
3. Gimbal bearing not properly installed.	3. Check engine alignment to determine if gimbal bearing is cocked, or improperly installed in gimbal housing.
4. Damaged u-joint shaft splines and/or engine coupler splines.	4. Inspect and replace if necessary.

Drive Unit Does Not Shift Into Gear; Remote Control Shift Handle Moves

NOTE: *For additional information on troubleshooting, refer to Sec. 2A and see “Troubleshooting Shift Problems.”*

Cause	Remedy
1. Shift cables improperly adjusted.	1. Adjust shift cables.
2. Shift cables not connected.	2. Install and adjust shift cables.
3. Inner core wire broken or loose.	3. Reconnect or replace inner core wire.

Drive Unit Does Not Shift Into Gear; Remote Control Shift Handle Does Not Move

NOTE: *For additional information on troubleshooting, refer to Sec. 2A and see "Troubleshooting Shift Problems."*

Cause	Remedy
1. Control box not properly assembled.	1. Properly reassemble control box.
2. Broken or damaged linkage in control box.	2. Repair linkage.
3. Controls improperly adjusted-cable end guide hitting brass barrel.	3. Adjust shift cables.

Drive Unit Shifts Hard

NOTE: *For additional information on troubleshooting, refer to Sec. 2A and see "Troubleshooting Shift Problems."*

Cause	Remedy
1. Shift cables improperly adjusted.	1. Adjust shift cables.
2. Damaged remote control or drive unit shift cable.	2. Replace cable(s) and adjust.
3. Shift cable too short (sharp bends) or too long (loops and long bends).	3. Select and install proper length cable.
4. Corroded shift cables.	4. Replace, adjust, and check for water leakage.
5. Internal wear in remote control box.	5. Repair as needed.
6. Shift cable attaching nuts too tight (end cannot pivot).	6. Properly install nuts.
7. Shift cable pivot ends are corroded, or not lubricated.	7. Clean and lubricate.

Drive Unit In Gear, Will Not Shift Out Of Gear

NOTE: *For additional information on troubleshooting, refer to Sec. 2A and see "Troubleshooting Shift Problems."*

Cause	Remedy
1. Shift cable broken.	1. Replace cable and adjust.
2. Cable end not connected in drive unit.	2. Remove and reinstall drive unit.
3. Remote control damaged.	3. Repair or replace remote control.
4. Internal shift mechanism damage.	4. Repair or replace as necessary.

Gear Housing Noise

Cause	Remedy
1. Metal particles in drive unit lubricant.	1. Disassemble, clean and inspect, and replace necessary components. (Refer to Sec. 3B, 3C, or 3D)
2. Propeller incorrectly installed.	2. Inspect mounting hardware. Install propeller correctly.
3. Propeller shaft bent.	3. Inspect and replace if necessary. (Refer to Sec. 3B, 3C, or 3D)
4. Incorrect gear shimming.	4. Check gear housing backlash and pinion gear height. (Refer to Sec. 3B, 3C, or 3D)
5. Worn or damaged gears and/or bearings caused by impact, overheating, or improper shimming.	5. Disassemble, inspect, replace. (Refer to Sec. 3B, 3C, or 3D)

Drive Shaft Housing Noise

Cause	Remedy
1. Steering lever contacting transom cutout opening in turns.	1. Modify transom cutout.
2. Engine flywheel housing contacting inner transom plate or exhaust pipe.	2. Determine cause for interference (loose engine mounts, transom too thin, etc.) and correct as necessary.
3. Propeller with untrue or out-of-balance blades.	3. Repair or replace, as required.
4. Abnormal sterndrive operation.	4. Instruct operator on proper operating technique.
5. U-joint cross and bearing assembly retaining rings improperly installed or of incorrect size.	5. Make sure that proper thickness retaining rings are used and that rings are fully seated in u-joint bearing cap grooves. (Refer to Sec 3A)
6. Excessive side-to-side play in u-joint cross and bearing assemblies.	6. Replace cross and bearing assembly.
7. U-joint bearing caps contacting center socket or drive shaft housing bearing retainer.	7. Make sure proper cross and bearing assemblies are used. If interference is slight, grind off area on center socket or retainer where bearing caps are hitting. If interference is severe, replace center socket. (Refer to Sec 3A)
8. U-joint cross and bearings rough.	8. Disassemble cross and bearing assemblies and inspect. DO NOT RELY ON FEEL. Replace assemblies if they show signs of scoring, galling, roughness, lack of lubricant, etc. (Refer to Sec 3A)
9. O-rings missing or flattened out on u-joint shaft causing shaft to rattle against ID of gimbal bearing.	9. Install new o-rings. (Refer to Sec 3A)

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Drive Shaft Housing Noise (Continued)

Cause	Remedy
10. Worn U-joint shaft splines and/or engine coupler splines.	10. Remove u-joint coupling end yoke and insert into gimbal bearing and engine coupling. Rotate shaft back-and-forth. If play is excessive, replace u-joint coupling end yoke and/or engine coupler, as necessary.
11. Engine alignment incorrect or engine coupler cocked.	11. Adjust alignment, making sure that alignment tool moves in-and-out of coupler freely. After proper alignment has been obtained, check for a cocked coupler by rotating engine coupler 1/2 turn and rechecking alignment. If proper alignment is no longer observed, coupler is cocked and must be replaced. (Refer to Sec 2)
12. Gimbal bearing rough.	12. Replace gimbal bearing. (Refer to Sec 4) **IMPORTANT: Gimbal bearing and carrier MUST BE replaced as an assembly as they are a matched set. Failure placed as an assembly as they are a matched set. Failure to do this may result in a loose bearing fit in carrier.**
13. Loose gimbal bearing.	13. Reinstall bearing using a new tolerance, ring if carrier is loose in gimbal housing. If bearing is loose in carrier, bearing assembly must be replaced. (Refer to Sec 4)
14. Gimbal bearing not fully seated in gimbal housing. Yoke moves back-and-forth in turns and may hammer against bearing if not fully seated.	14. Drive bearing assembly into place.
15. Excessive clearance between gimbal ring and gimbal housing. This could cause misalignment between bell housing and gimbal housing, and also may allow gimbal ring to vibrate up-and-down, in turns.	15. Check and adjust clearance. (Refer to sec 4)
16. Improperly installed or failed rear engine mounts. This will affect engine alignment, but usually is not detectable with engine alignment tool.	16. Check for uneven mount height, or loose or soft mounts. Make sure there is clearance between flywheel housing and fiber washer. If no clearance exist, mounts have probably sagged. Install mounts correctly or replace, as necessary.

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Drive Shaft Housing Noise (Continued)

Cause	Remedy
17. Boat transom too thin. **Thickness:** 2 in. (51mm) minimum, 2-1/4 in. (57mm) maximum	17. Add Thickness to transom.
18. Boat transom thickness uneven. This could affect engine to transom assembly alignment and is usually not detectable with alignment tool. **Variation:** 1/8 in. (3mm) maximum	18. Repair boat as necessary.
19. Bell housing contacting gimbal ring. This would cause knocking in the fully trimmed “In” position only.	19. Check for soft or split trim cylinder bushings, and loose or worn hinge pin bushings. (Refer to Sec 5B)
20. Stringer height uneven or transom assembly installed cocked on boat transom. This will affect engine alignment, but is usually not detectable with alignment tool.	20. Measure the distance between the engine flywheel housing and the inner transom plate on both sides. If distances are uneven, the problem may be due to uneven stringer height or a cocked transom assembly. Adjust the stringer height or relocate the transom cutout as required.
21. Weak boat transom or boat bottom that flexes under power and causes engine misalignment - this condition will usually cause engine coupler failure.	21. This condition can sometimes be detected by having someone apply force to the top of the drive unit while watching the inner transom plate. If movement can be observed, the transom is weak and must be repaired.
22. Rear engine mount attaching hardware improperly installed or missing.	22. Reinstall hardware correctly.
23. Engine mounting holes drilled off-center in inner transom plate engine supports or engine flywheel housing	23. Make sure the holes are equally spaced fore and aft, and are equal distance from the centerline.
24. Misalignment between bell housing, gimbal housing and engine coupler.	24. Contact your service center and arrange to have a technical service representative check the unit using a special gauge.

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Bravo Power Shift

System Does Not React

Cause	Remedy
1. Vacuum leaks.	1. With engine running, check for vacuum leaks. Squirt oil on fitting and hose connections, and on the shift cylinder-to-end plate joint. If oil is sucked in at any point, a vacuum leak exists. Repair leak.
2. Improper installation.	2. Reinstall.

System Binds

Cause	Remedy
1. Remote Control.	1. Disconnect input cable at power shift cylinder. Disconnect throttle cable at carburetor or injector pump. Operate remote control. If binding occurs, find cause of binding in either cable, or in remote control, and correct binding. If no binding occurs, proceed to step 2.
2. Vacuum drop-off.	2. Check vacuum drop-off. If vacuum drops off to “0” PSI in less than 5 seconds, install repair kit.
3. Cable movement.	3. Check movement of cable from shift plate to drive unit, including shifting linkage movement in drive unit, for binding. Adjust shift cable following procedures in Sec 2A.

Performance Troubleshooting

Low Full-Throttle Engine RPM

Cause	Remedy
1. Improper drive unit trim angle.	1. Properly adjust drive unit trim angle.
2. Damaged propeller.	2. Repair or replace.
3. Improper propeller pitch.	3. Water test boat using a lower pitch propeller.
4. Dirty or damaged boat bottom.	4. Clean and/or resurface boat bottom.
5. Drive installation too low on transom.	5. Contact boat manufacturer for installation specifications.
6. Permanent “hook” in boat bottom (some boats are built with a slight “hook” for correct boat performance).	6. Check for a “hook” in the boat bottom by placing a straight edge, at least 6 ft. (2m) long, under the bottom edge of the transom. If a “hook” is found, contact the boat manufacturer.
7. “Power hook” or weak boat bottom.	7. Water test boat. Boat will perform normally until hook develops at high speed: then loss of RPM and speed will occur. Contact boat manufacturer.

High Full-Throttle Engine RPM

Cause	Remedy
1. Propeller ventilating.	1. Determine cause for ventilation.
2. Improper propeller pitch.	2. Water test boat using a higher pitch propeller.
3. Propeller hub slipping.	3. Replace hub or replace propeller.
4. Drive installation too high on transom.	4. Contact boat manufacturer for installation specifications.
5. Engine coupler hub slipping.	5. Replace hub.

Propeller Ventilating/Cavitating

Cause	Remedy
1. Drive unit trimmed too high.	1. Trim drive unit IN/DOWN.
2. Incorrect propeller.	2. Install correct propeller.
3. Propeller hub slipping.	3. Replace hub.

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Poor Boat Performance And/Or Poor Maneuverability-Bow Too Low

Cause	Remedy
1. Improper drive unit trim angle.	1. Properly adjust drive unit trim angle.
2. Boat is bow heavy.	2. Redistribute boat load to stern. If bow overweight is caused by permanently installed fuel tank(s), etc., contact the boat manufacturer.
3. Boat is underpowered.	3. Check horsepower to weight ratio. Contact the boat manufacturer.
4. Permanent “hook” in boat bottom (some boats are built with a slight “hook” for correct boat performance).	4. Check for a “hook” in the boat bottom by placing a straight edge, at least 6 ft. (2m) long, under the bottom edge of the transom. If a “hook” is found, contact the boat manufacturer.
5. Power hook or weak boat bottom.	5. Water test boat. Boat will perform normally until hook develops at high speed: then loss of RPM and speed will occur. Contact boat manufacturer.

Poor Boat Performance And/Or Poor Maneuverability-Bow Too High

Cause	Remedy
1. Improper drive unit trim angle.	1. Properly adjust drive unit trim angle.
2. Boat is stern heavy.	2. Redistribute boat load to bow. If stern over weight is caused by permanently installed fuel tank(s), etc., contact the boat manufacturer.
3. Propeller pitch too high.	3. Water test the boat using a lower pitch propeller.
4. Permanent “rocker” in boat bottom (some boats are built with a slight “rocker” for correct boat performance).	4. Check for a “rocker” in the boat bottom by placing a straight edge, at least 6 ft. (2m) long, under bottom edge of the transom. If a “rocker” is found, contact the boat manufacturer.
5. Power hook or weak boat bottom.	5. Water test boat. Boat will perform normally until hook develops at high speed: then loss of RPM and speed will occur. Contact boat manufacturer.

Power Steering

Hard Steering - RideGuide Steering System

Cause	Remedy
1. Damaged steering cable.	1. Replace cable. (Refer to Sec 2)
2. Steering cable too short (sharp bends) or too long (loops and long bends).	2. Select and install proper length cable. (Refer to Sec 2A)
3. Steering cable corroded or not lubricated.	3. Lubricate or replace the cable.
4. RideGuide rack or rotary head not lubricated.	4. Disassemble and lubricate.

Hard Steering (Engine Running) - Power Steering System

Cause	Remedy
1. Low power steering pump fluid level.	1. Check fluid level. (Refer to Sec 6A)
2. Loose power steering pump drive belt.	2. Adjust belt tension. (Refer to Sec 6A)
3. Air in system.	3. Locate source of air in lines or fittings. Correct and air bleed system. (Refer to Sec 6A)
4. Fluid leak.	4. Locate and correct source of leak. (Refer to Sec 6A)
5. If the above 4 steps do not solve the problem, test the power steering system.	5. Test power steering system. (Refer to Sec 6A)

Power Steering System External Fluid Leaks

Cause	Remedy
1. Pump reservoir leaking at fill cap (reservoir too full).	1. Remove fluid to bring to proper level.
2. Pump reservoir leaking at fill cap (air or water in fluid).	2. Locate source of air or water and correct. Air may enter because of low reservoir fluid level or internal pump leak. Test Pump. (Refer to Sec 6A)
3. Loose hose connections.	3. Tighten hose connections.
4. Damaged hose.	4. Replace hose.
5. Bad cylinder piston rod seal.	5. Replace seal. (Refer to Sec 6A)
6. Damaged or worn control valve seals.	6. Replace seals. (Refer to Sec 6A)
7. Bad power steering pump seals and o-rings.	7. Repair pump. (Refer to Sec 6A)
8. Cracked or porous metal parts.	8. Replace part(s).

Power Trim Electrical System

NOTE: *The numbered callouts (eg. "4") in the Electrical System troubleshooting section refer to the wiring diagram on page 1C-15.*

Power Trim Pump Motor Will Not Run In The OUT/UP Or IN/DOWN Direction (Solenoids Do Not Click)

Cause	Remedy
1. 20 amp fuse blown.	1. Determine cause for the blown fuse and correct before replacing fuse. ***NOTE:*** *If fuse blows while trimming "Out"/"Up" or raising drive unit, problem may be due to grounded trim limit switch leads. To check for grounded condition, disconnect trim limit switch leads at bullet connector "14", "15", "16", and "17." If drive unit can now be raised (using "Trailer" switch), trim limit switch or leads are grounded.*
2. Power trim pump battery cables or wiring harness connections corroded or loose.	2. Clean and/or tighten connections "1", "2", "4", "10", "11", "12", and "18" as necessary.
3. Trim control wiring harness connector loose or corroded.	3. Clean and secure connection "13" as necessary.
4. 110 amp fuse blown (does not apply to intermittent problem).	4. Check for voltage at terminal "4." If no voltage indicated, determine cause of blown fuse.
5. Open circuit in trim control wiring harness.	5. Check for battery voltage at terminal "8" while trimming "Out"/"Up" and at terminal "6" while trimming "In"/"Down." If no voltage is indicated, check trim control for a loose or corroded connection or a damaged power supply lead in harness.
6. Thermal circuit breaker in pump motor open.	6. Replace commutator end plate assembly.

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Power Trim Pump Motor Will Not Run In The OUT/UP Or IN/DOWN Direction (Both Solenoids Click)

Cause	Remedy
1. Faulty solenoids or loose or corroded connections.	1. Check for battery voltage at terminal “5” (in wiring diagram) while trimming “In”/“Down” and at terminal “3” while trimming “Out”/“Up.” If no voltage is indicated, check connections “2,” “3,” “4,” and “5” and/or replace solenoids.
2. Pump motor brushes stuck, corroded or worn out.	2. Clean or replace as required.
3. Armature commutator dirty.	3. Clean or replace armature as required.
4. Armature faulty.	4. Test for shorted, open, or grounded condition and replace if needed.
5. Field and frame faulty.	5. Check for open or grounded condition. Replace field and frame assembly if needed.
6. Water or oil in motor.	6. Replace motor assembly.
7. Pump gears frozen.	7. Replace pump valve body and gear assembly.
8. Power trim pump harness or trim control harness shorted between “Out”/“Up” and “In”/“Down” circuit (pump trying to run in “Out”/“Up” and “In”/“Down” direction simultaneously).	8. Disconnect blue-white lead from solenoid terminal “8.” If pump motor will now run in the “In”/“Down” direction, a short in the harness exists. Repair or replace harness as needed.

Power Trim Pump Motor Runs In The OUT/UP Direction, But Not In The IN/DOWN Direction (IN/DOWN Solenoid Does Not Click)

Cause	Remedy
1. Loose or dirty solenoid connections.	1. Check connections “6” and “7” and clean and/or tighten as required.
2. Open “In”/“Down” circuit in trim control or pump wiring harness.	2. Check for battery voltage at terminal “6” while trimming “In”/“Down.” If no voltage is indicated, check for a loose or corroded “In”/“Down” circuit connection, damaged “In”/“Down” circuit lead or a faulty “In”/“Down” trim switch. Repair or replace as required.
3. Solenoid faulty.	3. Replace solenoid.

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Power Trim Pump Motor Runs In The OUT/UP Direction, But Not In The IN/DOWN Direction (IN/DOWN Solenoid Clicks)

Cause	Remedy
1. Loose or dirty solenoid connection.	1. Check connections “4” and “5.” Clean and/or tighten as necessary.
2. Faulty solenoid.	2. Check for battery voltage at terminal “5” while trimming IN/DOWN. If no voltage is indicated, replace solenoid.
3. Faulty IN/DOWN field winding.	3. Replace field and frame assembly.

Power Trim Pump Motor Runs In The IN/DOWN Direction, But Not In The OUT/UP Direction-Both Trim And Trailer Switches Inoperative-(OUT/UP Solenoid Does Not Click)

Cause	Remedy
1. Loose or dirty solenoid connections.	1. Check connections “8” and “9.” Clean and/or tighten as necessary.
2. Open OUT/UP circuit trim control or pump wiring harness.	2. Check for battery voltage at terminal “8” while trimming OUT/UP. If no voltage is indicated, check for a loose or corroded OUT/UP circuit connection, blown fuse (if trim control is so equipped), damaged OUT/UP circuit lead, or a faulty OUT/UP trim switch. Repair or replace as necessary.
3. Solenoid faulty.	3. Replace solenoid.

Power Trim Pump Motor Runs In The IN/DOWN Direction, But Not In The OUT/UP Direction-Both Trim And Trailer Switches Inoperative-(OUT/UP Solenoid Clicks)

Cause	Remedy
1. Loose or dirty solenoid connection.	1. Check connections “2” and “3.” Clean and/or tighten as necessary.
2. Faulty Solenoid.	2. Check for battery voltage at terminal “3” while trimming OUT/UP. If no voltage is indicated, replace solenoid.
3. Faulty OUT/UP field winding.	3. Replace solenoid.

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Trim Control OUT/UP Trim Switch Inoperative (Trailer Switch Operates)

Cause	Remedy
1. Trim limit switch lead bullet connectors loose or corroded.	1. Clean and/or tighten connections “14,” “15,” “16,” and “17” as necessary.
2. Trim limit switch or leads faulty.	2. Disconnect trim limit switch leads from trim harness. Connect a continuity meter between leads “16” and “17.” Continuity should be indicated with drive unit in full IN/DOWN position. If not, check for damaged leads or poor connections. If this is not the cause, replace limit switch.
3. Open trim control OUT/UP circuit.	3. Check for a loose or corroded OUT/UP circuit connection, damaged OUT/UP circuit lead, or faulty OUT/UP trim switch. Repair or replace as necessary.

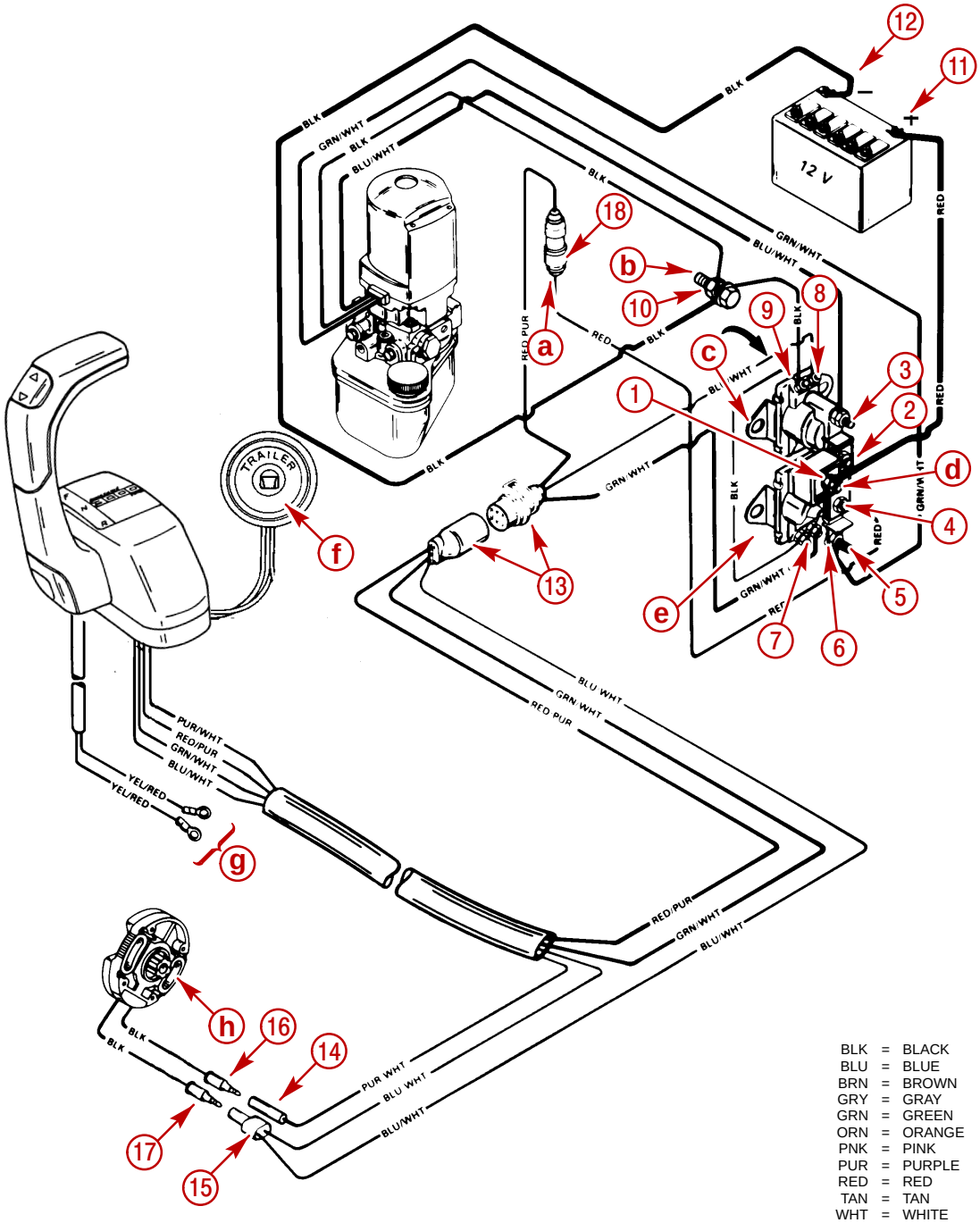
Trim Control Trailer Switch Inoperative (Trim OUT/UP Switch Functions)

Cause	Remedy
1. Open trim control trailer circuit.	1. Check for a faulty trailer switch, loose or corroded connections, or damaged trailer circuit lead.

Trim System Functions While Unattended

Cause	Remedy
1. Faulty trim or trailer switch.	1. Replace switch.
2. Shorted trim pump harness or trim control harness.	2. Repair or replace as required.

Power Trim System Wiring Diagram



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BLK = BLACK
BLU = BLUE
BRN = BROWN
GRY = GRAY
GRN = GREEN
ORN = ORANGE
PNK = PINK
PUR = PURPLE
RED = RED
TAN = TAN
WHT = WHITE
YEL = YELLOW
LIT = LIGHT
DRK = DARK

a - 20 Amp Fuse
b - Ground Bolt (Floor Mount)
c - “UP” Solenoid
d - 110 Amp Fuse
e - “DOWN” Solenoid
f - Trailer Switch
g - Neutral Switch to Instrument Wiring Harness
h - Trim Limit Switch

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Power Trim Hydraulic System

NOTE: *The numbered callouts (eg. "5") in the Hydraulic System troubleshooting section refer to the hydraulic schematic on page 1C-19.*

Drive Unit Cannot Be Trimmed OUT/UP Or Trims Slowly Or With Jerky Movements

Cause	Remedy
1. Power Trim pump oil level low.	1. Check for cause of low oil level and correct. Add oil and bleed trim system.
2. Air in trim system.	2. Check for cause of entry and correct. Add oil to pump and bleed air from system.
3. O-rings damaged on Manual Release Valve (if so equipped) or valve not completely closed.	3. Replace valve and/or close completely.
4. Insufficient pump pressure or pump. shuttle valve stuck.	4. Test. If shuttle "1" is stuck, replace pump adaptor (Refer to Sec 5A). If pressure is low, replace adaptor or attempt to repair by replacing the following components: ● OUT/UP Pressure Relief Valve ● Thermal Relief Valve
5. Hoses reversed on one cylinder only.	5. Connect hoses "7" and "8" Correctly.
6. Trim cylinder(s) binding.	6. Check for cause of binding (bent piston rod, scored cylinder, etc.). Repair or replace as necessary.
7. Gimbal housing-to-trim pump hydraulic hose pinched.	7. Replace hose "7."
8. Up pressure relief valve has dirt particles under check ball.	8. Replace with a new valve kit.

Drive Unit Will Not Stay In Trimmed OUT/UP Position When Underway

Cause	Remedy
1. Air in trim system.	1. Check for cause of entry. Fill and bleed system.
2. Shuttle Valve (Poppet Valve).	2. Check for dirt. Install new poppet valve.

Drive Unit Trails OUT/UP On Deceleration Or When Shifting Into Reverse (Unit Thumps When Shifting)

Cause	Remedy
1. Trim cylinder(s) leaking internally.	1. Test according to appropriate service manual. Rebuild or replace cylinders as necessary. (Refer to Sec 5B)
2. Trim pump IN/DOWN circuit leaking internally.	2. Test according to appropriate service manual. Replace adaptor or attempt to repair by replacing the Pilot Check Valves or Seals. (Install Trim Pump Rebuild Kit)

Oil Foams Out Of Pump Fill/Vent Screw

Cause	Remedy
1. Contaminated oil.	1. Flush system with clean oil refill pump and bleed trim system.
2. Oil level low.	2. Check for cause of low oil level and correct. Add oil to pump and bleed system.

Drive Unit Cannot Be Lowered From UP Position Or Lowers With Jerky Movements

Cause	Remedy
1. Air in trim system.	1. Check for cause of entry. Fill and bleed trim system.
2. Low oil level.	2. Add oil.
3. Damaged O-rings on manual release valve (if so equipped).	3. Replace valve.
4. Insufficient IN/DOWN pressure or shuttle valve stuck.	4. Test. If shuttle is “1” stuck, replace pump adaptor. (Refer to Sec 5A) If pressure is low, replace adaptor or attempt to repair by replacing the following items: ● IN/DOWN pressure relief valve “6”
5. Trim cylinder(s) block leaking internally.	5. Test. Rebuild or replace cylinder as necessary.
6. Trim cylinder(s) binding.	6. Check for cause of binding. Repair or replace as necessary.
7. Gimbal housing-to-trim pump hydraulic hose pinched.	7. Replace hose “8.”
8. Hoses reversed on one trim cylinder only.	8. Reconnect hoses correctly.
9. Drive unit binding in gimbal ring.	9. Check for cause of binding and replace.
10. Down Pressure relief valve (6) has dirt particles under check ball.	10. Replace with a new valve kit.

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Drive Unit Will Not Stay In Full UP Position For Extended Periods

Cause	Remedy
1. External leakage.	1. Check for cause and correct. Add oil to pump and bleed trim system.
2. Damaged o-ring on manual release valve (if so equipped) or valve not closed completely.	2. Replace valve and/or close completely.
3. Pump OUT/UP circuit leaking internally.	3. Test. (Refer to Sec 5A) Replace adaptor “2” or attempt to repair by replacing the following: ● Thermal relief valve “4” ● Pilot check valve or seals “9”
4. Trim cylinder(s) leaking internally and pump DOWN circuit leaking internally (both must be faulty to cause this problem).	4. Rebuild cylinders “5.” Repair or replace adaptor “2” as required.

Drive Will Not Stay In The Trimmed OUT/UP Position When Underway

Cause	Remedy
1. Air in trim system.	1. Check for cause of entry. Fill and bleed system.
2. Leaky shuttle poppet valve.	2. Install repair kit for shuttle valve “1.”

Drive Unit Trails OUT/UP On Deceleration Or When Shifting Into Reverse (Unit Thumps When Shifting)

Cause	Remedy
1. Trim cylinders(s) leaking internally.	1. Test. (Refer to Sec 5A) Rebuild or replace cylinders as necessary.
2. Trim pump IN/DOWN circuit leaking internally.	2. Test. (Refer to Sec 5A) Replace adaptor or attempt to repair by replacing the following: ● Pilot check valves or seals “9” ● Install trim pump rebuild kit

Oil Foams Out Of Pump Fill/Vent Screw

Cause	Remedy
1. Contaminated oil.	1. Flush system with clean oil refill pump and bleed trim system.
2. Oil level low.	2. Check for cause of low oil level and correct. Add oil to pump and bleed system.

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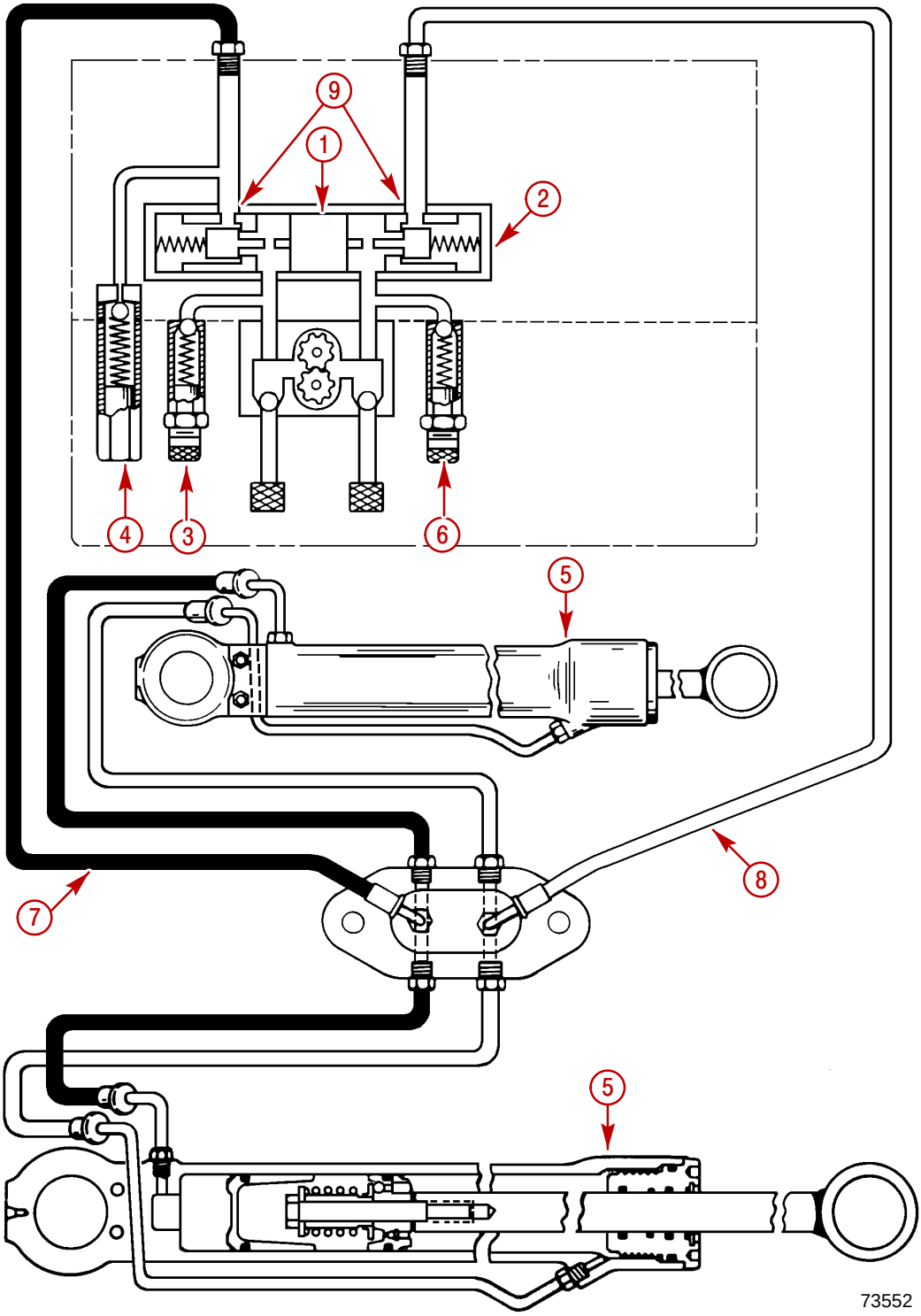
Power Trim Hydraulic Schematic



1 - Shuttle
2 - Pump Adaptor
3 - “Up”/“Out”Pressure Relief Valve
4 - Thermal Relief Valve
5 - Trim Cylinder
6 - “In”/“Down” Pressure Relief Valve
7 - “Up”/“Out” Hose
8 - “In”/“Down” Hose
9 - Pilot Check Valves

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Auto Trim Electrical System

NOTE: *The numbered callouts (eg. “14”) in the Electrical System troubleshooting section refer to the wiring diagram on page 1C-26.*

Pump Motor Will Not Run “Up” Or “Down” In Either Manual Or Auto Mode (Solenoids Click)

Cause	Remedy
1. Pump positive battery cable connection loose or corroded.	1. Check cable “14.”
2. 110 amp fuse blown or loose, or corroded solenoid connection.	2. Check for voltage at terminal “5.”
3. Pump motor brushes stuck, corroded or worn out.	3. Clean or replace.
4. Armature commutator dirty.	4. Clean or replace.
5. Armature faulty.	5. Test and replace if bad.
6. Field and frame faulty.	6. Test and replace if bad.
7. Pump gears frozen.	7. Replace pump adaptor.
8. Trim harness shorted between “Up” and “Down” circuit.	8. Disconnect blue-white lead “2” from solenoid terminal. If pump motor will now run in the “Down” direction, a short in the harness is indicated.

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Pump Motor Will Not Run Up Or Down In Either Manual Or Auto Mode (Solenoids Do Not Click)

Cause	Remedy
1. Pump negative battery cable loose, corroded or damaged.	1. Check cable “13” for a loose or corroded connection, or damage.
2. Mode switch wiring harness connector is loose at pump.	2. Secure connection “47.”
3. Faulty thermal circuit breaker in pump motor.	3. Connect a jumper wire between terminals “1” and “7.” If pump now operates, circuit breaker is faulty and field and frame assembly must be replaced.
4. Open circuit in mode switch wiring harness.	4. With ignition switch in “Run” position and mode switch in “Manual” mode, check for voltage at terminal “8” while trimming “Up” and terminal “12” while trimming “Down.” If no voltage is indicated, refer to items “5” and “6” immediately following.
5. No power to mode switch.	5. Check for voltage at terminal “25” (with ignition switch in “Run” position). If no voltage is indicated, check power lead for a poor connection.
6. Faulty mode switch.	6. Check for voltage at terminal “24” (with mode switch in “Auto” mode) and terminal “26” (with switch in the “Manual” mode). Replace switch if no voltage is indicated.

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Pump Motor Will Not Stop Running Down In Auto Mode (Trim UP/OUT Switch And Trailer Switch Inoperative In Manual Mode)

NOTE: *An internal timer in the control module stops the pump motor 50 seconds after this problem condition occurs.*

Cause	Remedy
1. Loose or dirty solenoid connection.	1. Check connections “7” and “8.”
2. Faulty solenoid.	2. Check for voltage at terminal “8” while trimming “Up” (in Manual mode). If voltage exists, an open condition in solenoid is indicated and solenoid must be replaced. If no voltage is indicated, refer to steps 3 thru 6 following.
3. Loose or corroded trim limit switch lead connections.	3. Check connections “32” and “36.”
4. Faulty trim limit switch.	4. Disconnect trim limit switch leads “32” and “36” and connect a continuity meter between leads. Continuity should exist with drive unit in “Down” position. If not, readjust or replace switch as necessary.
5. Open circuit in wiring harness.	5. Check leads “30,” “35,” “46,” and “2” for loose or corroded connections or physical damage.
6. Faulty control module.	6. Replace.

Pump Motor Will Not Run Up Or Down In Auto Mode (Manual Mode Functions Properly)

Cause	Remedy
1. Control module 20 amp fuse blown “15.”	1. Determine cause for blown fuse and correct before replacing fuse.
2. Open in control module battery cables or wiring harness.	2. Check cables “16” and “18,” and lead “20.”
3. Faulty mode switch.	3. Check for voltage at terminal “24” and “25” with switch in Auto mode. If voltage exists at terminal “25,” but not “24,” switch is faulty.
4. Faulty control module.	4. Replace.

Trim System Completely Inoperative In Manual Mode (Auto Mode Functions Properly)

Cause	Remedy
1. Faulty mode switch.	1. Check for voltage at terminal “26” with mode switch in “Manual” mode. If no voltage is indicated, replace switch.
2. Open circuit in wiring harness.	2. Check leads “27” and “33” for loose or corroded connections or damage.

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Pump Motor Will Run Up, But Not Down In Both Manual And Auto Modes (Down Solenoid Does Not Click)

Cause	Remedy
1. Loose or dirty solenoid connections.	1. Check connections “4,” “7,” and “12.”
2. Faulty mode switch or open in Down circuit.	2. Check for voltage at terminal “12” while trimming Down (in “Manual” mode). If no voltage is indicated, repeat test at terminal “22” and “23.” If voltage exists at terminal “23,” but not at “22”, switch is faulty. If voltage is present at terminal “22,” check leads “3” and “48” and connector “47” for an open condition.
3. Faulty “Down” solenoid.	3. Replace.

Pump Motor Will Run Up, But Not Down In Both Manual And Auto Modes (Down Solenoid Clicks)

Cause	Remedy
1. Loose or dirty solenoid connections.	1. Check connections “10” and “11.”
2. Faulty solenoid.	2. Check for voltage at terminal “11” while trimming Down (in “Manual” mode). If no voltage is indicated, replace solenoid.
3. Faulty Down field winding.	3. Replace field and frame.

Pump Motor Runs Down, But Not Up In Both The Manual And Auto Modes (Up Solenoid Clicks)

Cause	Remedy
1. Loose or dirty solenoid connections.	1. Check connections “5” and “6.”
2. Faulty solenoid.	2. Check for voltage at terminal “6” while trimming Up. If no voltage is indicated, replace solenoid.
3. Faulty Up field winding.	3. Replace field and frame.

Pump Motor Will Run “Down,” But Not “Up” In Auto Mode (Manual Mode Functions Properly)

Cause	Remedy
1. Open circuit in control module sense lead.	1. Check lead “17” for loose or corroded connections or damage.
2. Faulty control module.	2. Replace.

Pump Motor Will Run Up, But Not Down In Auto Mode (Manual Mode Functions Properly)

Cause	Remedy
1. Faulty mode switch.	1. Check for voltage at terminal “21” and “22” while turning ignition switch to “Run” position (in Auto mode). If voltage exists at “21” but not at “22,” switch is faulty.
2. Open circuit in wiring.	2. Check lead “19” for a loose or corroded connection or damage.
3. Faulty control module.	3. Replace.

Trim “Down”/“In” Switch Inoperative In Manual Trim Control (Trim “Up”/“Out” Switch And Trailer Switch Function, Auto Mode Functions Properly)

Cause	Remedy
1. Faulty “Down” switch in manual trim control.	1. Check for voltage at terminal “38” while trimming Down” (in “Manual” mode). If no voltage is indicated, switch is faulty.
2. Open circuit in wiring harness.	2. Check for voltage at terminal “23” while trimming “Down.” If no voltage is present, check leads “28” and “34” for a loose or corroded connection or damage.
3. Faulty mode switch.	3. Check for voltage at terminal “22” while trimming “Down.” If no voltage exists, switch is faulty.

Trim “Up”/“Out” Switch Inoperative In Manual Trim Control (Trim “Down”/“In” Switch Functions, Auto Mode Functions Properly)

Cause	Remedy
1. Trim 20 amp fuse “43” blown (if so equipped).	1. Determine cause for blown fuse and correct before replacing fuse.
2. Open in power supply lead to trim and trailer switch.	2. Check voltage at terminal “44.” If no voltage is indicated, check lead “45” for a poor connection or damage.
3. Faulty trim UP/OUT switch (applies only to trim controls where it is necessary to actuate trim UP switch in order for trailer switch to function).	3. Check for voltage at terminal “40” while actuating trim UP/OUT switch. Replace switch if no voltage is indicated.

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Trailer Switch In Manual, Trim Control Inoperative (Trim UP/OUT Switch Functions)

Cause	Remedy
1. Faulty trailer switch.	1. Check for voltage at terminal “41” and “42” while actuating trailer switch. If voltage exists at terminal “42,” but not at terminal “41,” a faulty switch is indicated. If no voltage exists at terminal “42,” check power supply lead for an opening.
2. Opening in wiring.	2. Check lead “39” for damage or a loosened or corroded connection.

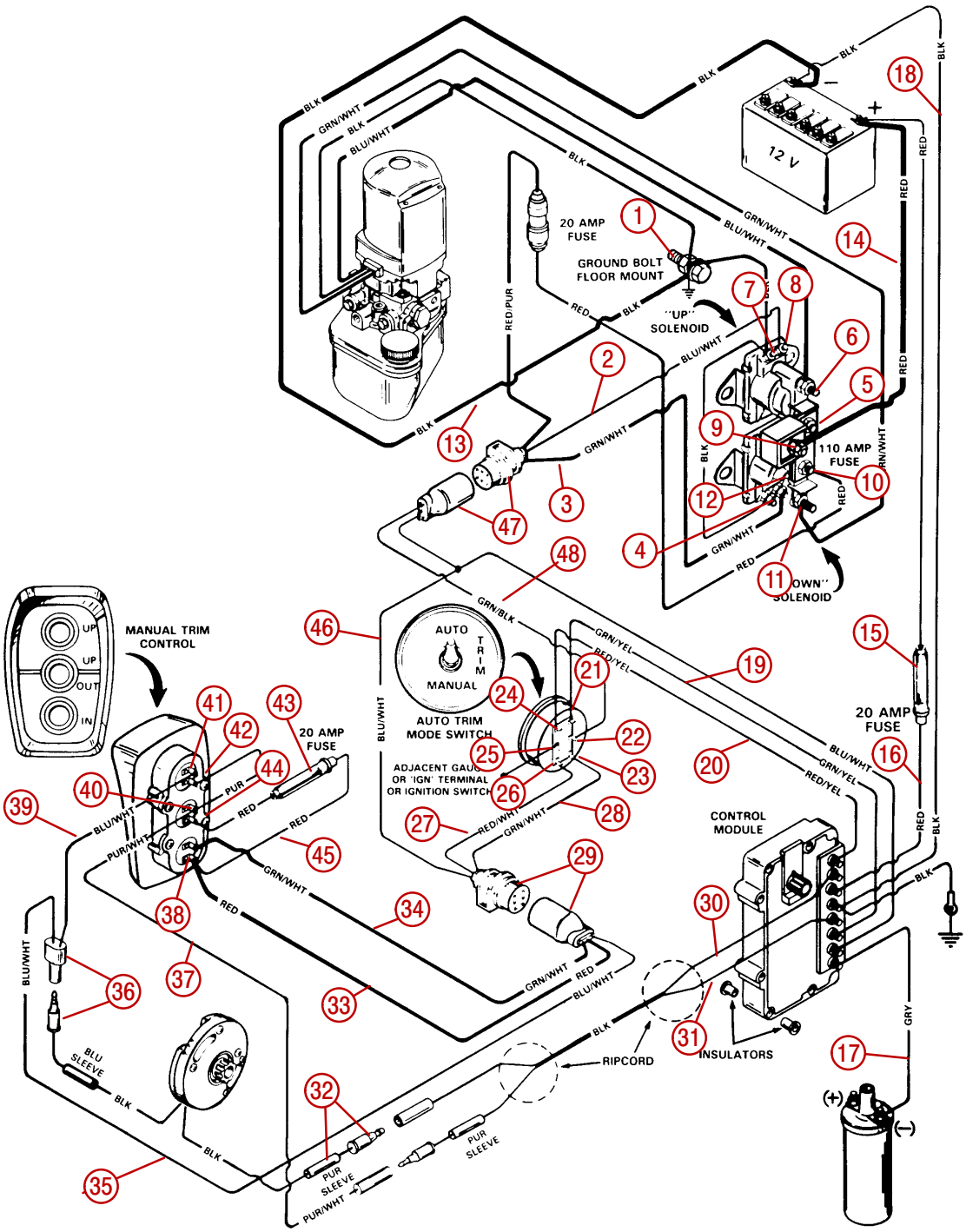
Boat Is On Plane Well Before Drive Unit Begins To Trim Out

Cause	Remedy
1. Control module adjustment incorrect.	1. Adjust. (Refer to Sec 5)
2. Faulty control module.	2. Replace control module.

Boat Is Not On Plane Before Drive Unit Begins To Trim Out

Cause	Remedy
1. Control module adjustment incorrect.	1. Adjust. (Refer to Sec 5)
2. Faulty control module.	2. Replace control module.

Auto Trim II System Wiring Diagram



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BLK ● Black
BLU ● Blue
BRN ● Brown
GRY ● Gray
GRN ● Green
ORN ● Orange
PNK ● Pink
PUR ● Purple
RED ● Red
TAN ● Tan
WHT ● White
YEL ● Yellow
LIT ● Light
DRK ● Dark

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Corrosion Protection

Corrosion On Underwater Parts, Without MerCathode Or Impressed Current Protection

Cause	Remedy
1. Sacrificial anode(s) consumed.	1. Replace anode(s) when 2/3 consumed.
2. Stainless steel propeller installed.	2. Add MerCathode (impressed current protection) or additional sacrificial anodes.
3. Sacrificial anode(s) not grounded to drive.	3. Remove anode(s), clean contact surface, reinstall, check continuity.
4. Loss of continuity between underwater parts & ground.	4. Provide good ground connections.
5. Shore power causing overload of anode(s) and/or MerCathode.	5. Disconnect shore power or install Quicksilver isolator.
6. Paint on drive heavily abraded (exposed metal).	6. Prime and repaint, and/or install additional anode(s).
7. Sacrificial anode(s) painted.	7. Remove paint or replace anode(s).
8. Drive tilted so far that anode(s) are out of the water.	8. Leave drive down, install additional anode (below waterline), or transom mount a MerCathode.
9. Only power trim cylinders corroded.	9. Provide good ground to drive. All parts must be grounded.
10. Corrosion in area of exhaust outlets (exhaust deposits can cause corrosion).	10. Remove deposits with marine or auto wax.
11. Corrosion occurring after unit removed from saltwater.	11. Wash exterior and flush interior with fresh water.

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Corrosion On Underwater Parts, With MerCathode Or Impressed Current Protection (Drive Corroding)

Cause	Remedy
1. Poor connection between reference electrode (brown) lead or anode (orange) lead and MerCathode controller.	1. Clean and/or tighten connection. Repair wiring.
2. Faulty MerCathode reference electrode.	2. Disconnect reference electrode lead (brown) from the controller “R” terminal. Connect the lead to positive (+) terminal of a digital multi-meter (set on 0-2000 millivolt scale). Connect negative (–) meter lead to negative (–) battery terminal. Note meter reading; then repeat the test with a test silver/silver chloride reference electrode held behind the drive. The same reading should be obtained in both cases. If not, replace the reference electrode.
3. Faulty MerCathode controller.	3. With anode and reference electrode leads connected to controller, connect a jumper wire between “R” and “–” terminals on controller. Connect positive (+) lead of volt meter (set on 0-20 scale) to “A” terminal on controller. Connect the negative (–) meter lead to the negative (–) controller terminal. Reading should be as follows: ● Freshwater Areas = 11.5 volts minimum ● Seawater Areas = 3.55 volts minimum If the reading is low, replace the controller.
4. Too much cathode (such as stainless steel).	4. MerCathode system overpowered by large quantity of stainless steel below the waterline.
5. Loss of continuity between drive components and ground.	5. Ensure continuity (check continuity wires and washers).
6. Sacrificial anodes consumed, painted, or inoperative.	6. Replace anodes.
7. MerCathode reference electrode or anode painted.	7. Remove paint or replace anode or MerCathode reference electrode.

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Corrosion On Underwater Parts, With MerCathode Or Impressed Current Protection - "Drive Corroding" - (Continued)

Cause	Remedy
8. No power to MerCathode controller.	8. Connect positive (+) lead of volt meter (set on 0-20 volt scale) to positive (+) terminal on the controller and negative (-) volt meter lead to negative (-) terminal. Meter should indicate battery voltage. Check for blown fuse (if so equipped) on a standard MerCathode system. Clean the connection or repair wiring as required.
9. MerCathode system not functioning	9. a. Check the fuse in the hot lead. b. Check battery. c. Check for loose connections at controller and battery. d. Check the grounding wire between the drive and the controller.

Corrosion On Underwater Parts, With MerCathode Or Impressed Current Protection (Drive Over-Protected)

Cause	Remedy
1. Faulty MerCathode reference electrode.	1. Disconnect reference electrode lead (brown) from “R” terminal on controller. Connect the lead to the positive (+) terminal of a digital multimeter (set on 0-2000 millivolt scale). Connect the negative (-) meter lead to the negative (-) battery terminal. Note the meter reading; then repeat the test with a test silver/silver chloride reference electrode held behind the drive. The same reading should be obtained in both cases. If not, replace the reference electrode.
2. Faulty MerCathode controller.	2. a. Check controller output. If the hull potential indicates overprotection, remove the reference electrode lead from the controller. If the controller is off (no impressed current called for) the voltage between the negative (black) and the anode should be less than 1 volt. If your digital voltmeter can measure amperage; with the reference electrode disconnected, the amperage between the negative on the controller and the anode terminal should be less than 1 milli-amp. b. Replace the controller.
3. Stray current corrosion (electrical current leaves a metal conductor and creates a path through the water).	3. Disconnect electrical components one at a time and observe the multimeter reading until you eliminate the high reading (see Troubleshooting Procedures). Correct the source of the stray current.
4. Poor connection between the MerCathode reference electrode lead (brown) and the “R” terminal on the controller.	4. Clean and/or tighten the connection. Repair wiring as needed.
5. MerCathode system not functioning.	5. a. Check the fuse in the hot lead. b. Check battery. c. Check for loose connections at controller and battery. d. Check the grounding wire between the drive and the controller.

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Testing Procedure for Corrosion Protection

1. Unplug shore power (if so equipped).
2. Measure hull potential with silver/silver chloride reference electrode and digital volt/ohm meter.

READINGS

	Potential	Diagnosis
Saltwater	Below 850 millivolts	Drive is corroding, see **(DRIVE CORRODING)**, p. 1C-28
	Between 850 - 1100 millivolts	Drive is protected
	Above 1100 millivolts	Drive is overprotected, see **(DRIVE OVERPROTECTED)** p. 1C-30

	Potential	Diagnosis
Freshwater	Below 750 millivolts	Drive is corroding, see **(DRIVE CORRODING)**, p. 1C-28
	Between 750 - 1050 millivolts	Drive is protected
	Above 1050 millivolts	Drive is overprotected, see **(DRIVE OVERPROTECTED)** p. 1C-30

CORROSION SYMPTOMS

- Paint blistering (usually on sharp edges)
- Loosely adhering white corrosion products on exposed aluminum surfaces (do not confuse these with tenaciously clinging calcium carbonate deposits)
- Aluminum pitting

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REMOVAL, INSTALLATION AND ADJUSTMENTS

Section 2A - All Models

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Installation Specifications

Torque Specifications

NOTE: *Securely tighten all fasteners not listed below.*

DESCRIPTION	TORQUE		
	lb. in.	lb. ft.	N·m
Exhaust Pipe to Gimbal Housing Screws		23	31
Propeller Nut [1]		55	75
Drive Unit Shift Cable Locknut	Tighten Nut Until It Bottoms Out Against Flat Washer, then Loosen 1 Turn		
Steering Cable Coupler Nut		35	48
Steering system Pivot Bolts		50	68
Transom Assembly Attaching Screws and Nuts		23	31
Power Steering Hydraulic Hose Fittings		23	31
Sterndrive Unit to Bell Housing Attaching Nuts		50	68

[1]: Amount specified is MINIMUM.

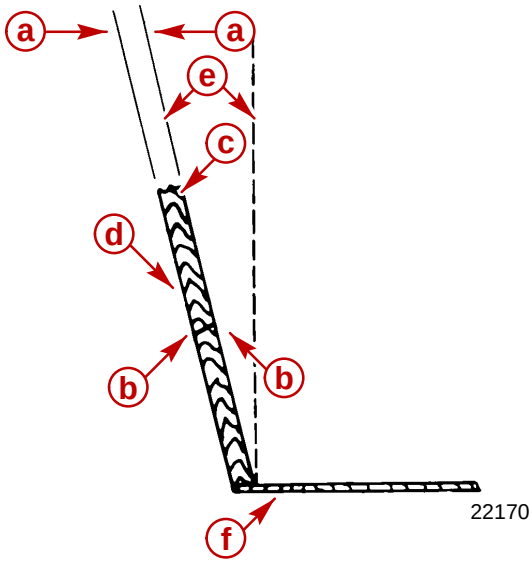
Lubricants/Sealers/Adhesives

DESCRIPTION	PART NUMBER
Quicksilver 2-4-C Marine Lubricant with Teflon	92-825407A12
Quicksilver Special Lubricant 101	92-13872A1
Perfect Seal	92-34227-1
Liquid Neoprene	92-25711--2
Quicksilver Anti-Corrosion Grease	92-78376A6
Quicksilver Engine Coupler Spline Grease	92-816391A4

Special Tools

DESCRIPTION	PART NUMBER
Shift Cable Adjustment Tool	91-12427
Engine Alignment Tool Assembly	91-805475A1

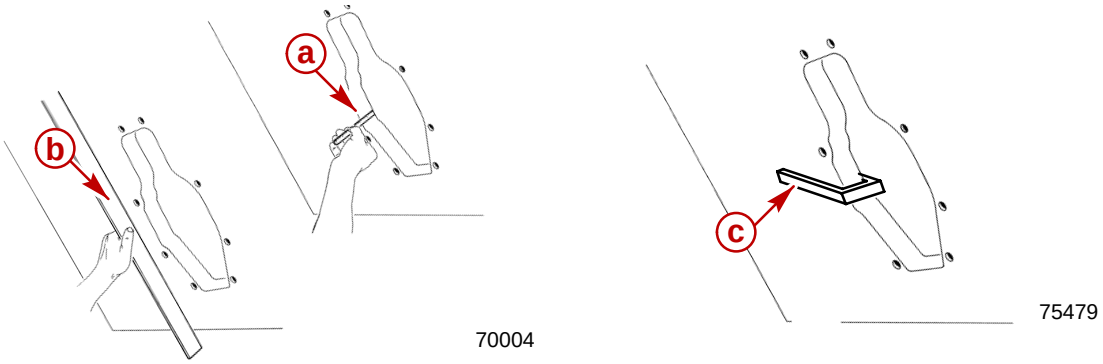
Transom Specifications



a - Transom Thickness - 2 - 2-1/4 in. (51mm-57mm)
b - Transom Surfaces - Parallel to within 1/8 in. (3 mm)
c - Area Covered by Inner Transom Plate - Flat to within1/8 in. (3.2 mm)
d - Area Covered by Gimbal Housing Assembly - Flat to within 1/16 in. (1.6 mm)
e - Transom Angle - 13° to 16°
f - Keel (If Equipped) - Remove keel 4 ft. (1.2 m) forward from transom

Checking Transom Thickness

Ensure transom surface thickness and flatness conform to minimums specified in “Installation Specifications” listed previously.



a - Measuring Thickness
b - Measuring Flatness
c - Suitable Mandrel To Check For Uniform Transom Thickness

NOTE: *Transom must be between 2” (51 mm) and 2-1/4” (57 mm) a distance of 8” (203 mm) to either side of the vertical centerline.*

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Special Information

Bravo Three Notice: Trim-In Limit Blocks or Limit Spacer

NOTE: *Some earlier Bravo Three models will be equipped with Trim-In Limit Blocks, later model Bravo One, Two and Three will have a Trim-In Limit Spacer. Refer to Section 4A for information on Removal, Installation or Adjustment of Trim-In Limit Blocks.*

It has been brought to our attention that some boats (predominantly deep-Vee heavy boats) will roll up on their side under certain, specific, operating conditions. The roll can be either to port or starboard and may be experienced while moving straight ahead, or while making a turn. The roll occurs most frequently at or near maximum speed, with the drive unit trimmed at or near full IN. While the boat will not roll completely over, the roll may be sufficient to unseat the operator or passengers, and thereby create an unsafe situation.

The roll is caused by stern lift. Stern lift can be created by excessive drive unit trim IN. Under these extreme stern lift/bow down conditions instability can be created which may cause the boat to roll. Weight distribution to the stern can reduce stern lift and, in some circumstances, eliminate the condition. Weight distribution in the bow, port or starboard, may worsen the condition.

The Trim-in limit devices reduce stern lift by preventing the drive unit from reaching the last few degrees of full trim under. While this device should reduce the rolling tendency, they may not eliminate the tendency entirely. The need for these trim-in limit blocks or spacer, and the effectiveness of them, can only be determined through boat testing and is ultimately the responsibility of the boat manufacturer.

⚠ WARNING

It is recommended that only qualified personnel remove or adjust the Trim-In Limit Blocks or adjust the Trim-In Limit Spacer. Boat must be water tested after removing or adjusting the device to ensure that the modified trim IN range does not cause the boat to exhibit an undesirable boat handling characteristic if the drive unit is trimmed IN at higher speeds. Increased trim IN range may cause handling problems on some boats which could result in personal injury.

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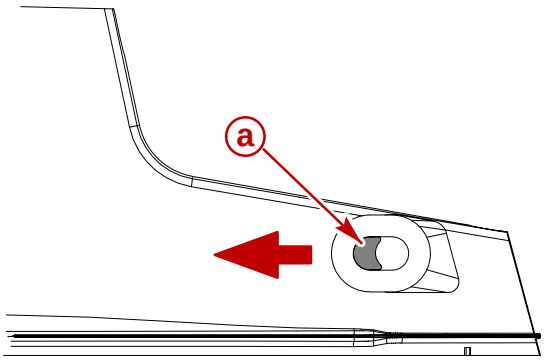
IMPORTANT: On Bravo One, Two and Three Models, the "Trim-In Limit Spacer" (If equipped), must be properly positioned before installing the trim cylinder anchor pin in the following steps.

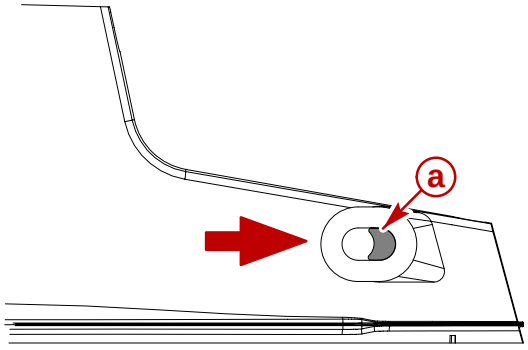
NOTE: *When removing the sterndrive unit, make a note of the position of the Spacer for reference when reinstalling the drive unit.*

1. If equipped, ensure that the Trim-In Limit Spacer is positioned as shown for the appropriate Bravo model.



75157

Bravo One and Two (Positioned Forward)



75158

Bravo Three (Positioned Aft)

a - Trim-In Limit Spacer

IMPORTANT: The position of the Trim-In Limit Spacer on the Bravo Three sterndrive unit should only be changed after the boat has been properly tested. Contact the boat manufacturer if you are not sure of the original position for a particular boat application.

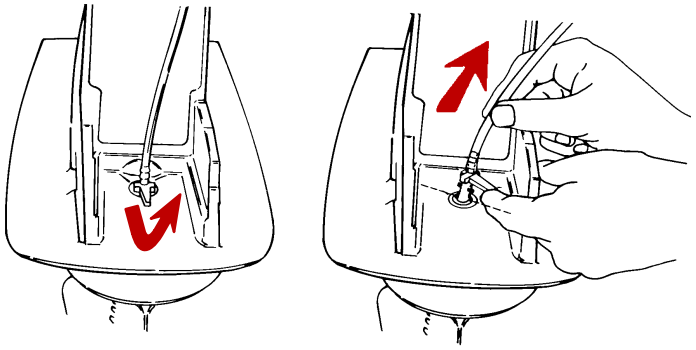
Sterndrive Unit Removal

1. Shift remote control into neutral.
2. Trim the drive unit to the full “up” position.

⚠ CAUTION

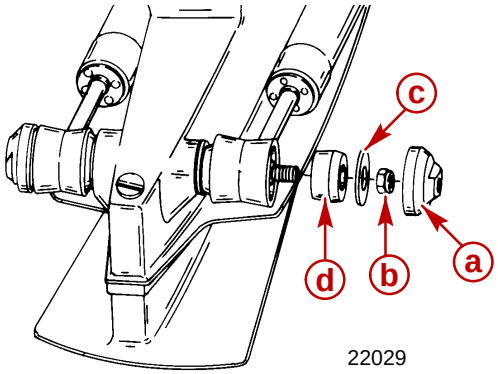
Avoid speedometer hose fitting damage. Disconnect the speedometer hose fitting from the drive shaft housing before removing the sterndrive unit.

3. Disconnect the speedometer hose fitting from the drive shaft housing.



22025

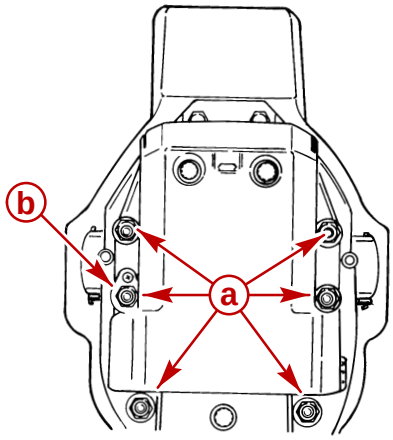
4. Trim the drive unit to the full “down” position and remove the power trim cylinder from the aft end of the drive shaft housing.



22029

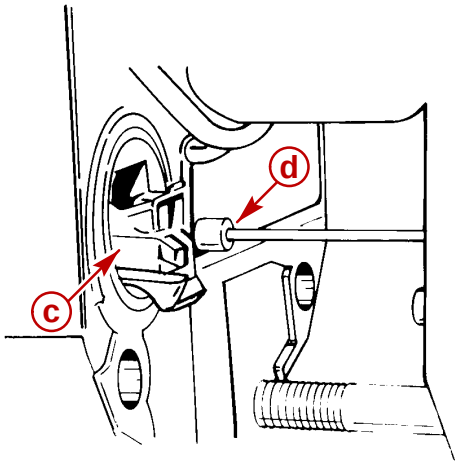
a - End Cap
b - Nut
c - Small I.D. Washer
d - Rubber Bushing

5. Remove the locknuts holding the sterndrive onto the bell housing, then remove the sterndrive unit. Make sure the shift cable linkage jaws open and release the shift cable end.



22031

a - Locknuts and Washers
b - Ground Plate (Continuity Washer Not Used Here)



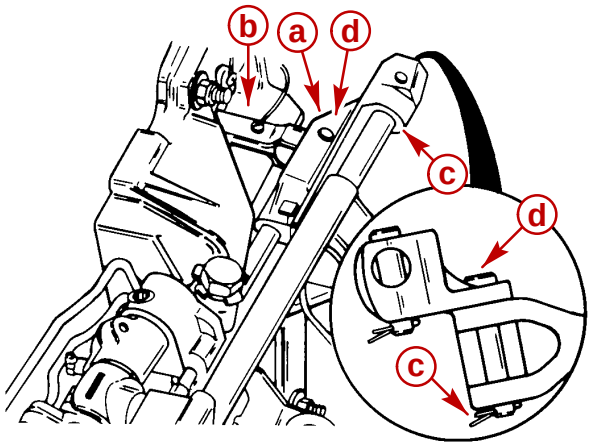
22025

c - Shift Linkage Jaws (Open)
d - Shift Cable End (Released from Jaws)

Transom Assembly Removal

NOTE: *When removing the transom assembly, it is not necessary to disconnect the power steering hoses from the power steering control valve.*

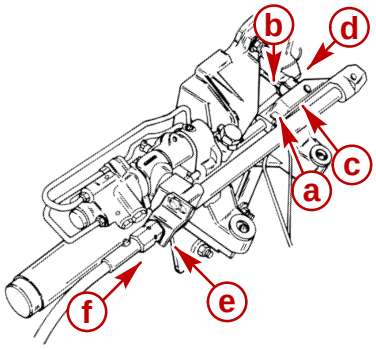
1. Completely disconnect the power steering assembly.
   a. Disconnect the clevis pin from the steering lever.



50352

a - Clevis
b - Steering Lever
c - Cotter Pin
d - Clevis Pin

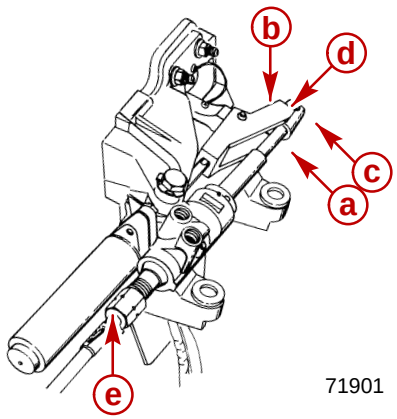
   b. Remove the cotter pin, clevis pin and lock plate (on earlier style control valve) to disconnect the steering cable.



22023

Earlier Style Control Valve

a - Cable End
b - Clevis
c - Cotter Pin
d - Clevis Pin
e - Lock Plate (Earlier Style Only)
f - Coupler Nut



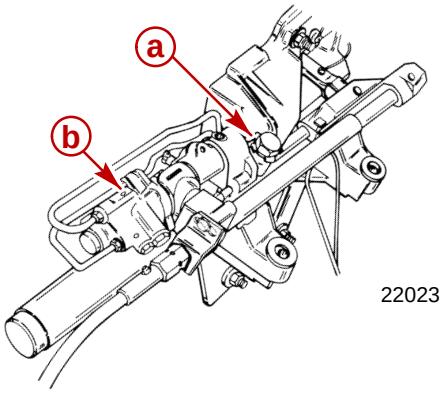
71901

Later Style Control Valve

a - Cable End
b - Clevis
c - Cotter Pin
d - Clevis Pin
e - Coupler Nut

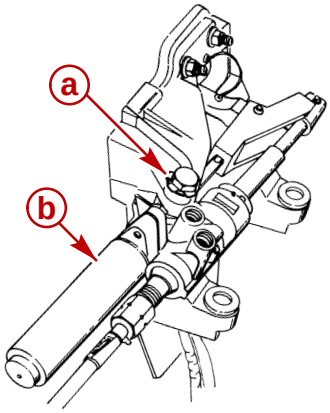
c. Remove the pivot bolt.

d. Remove the power steering control valve and lay it on top of the engine.



22023

Earlier Style Control Valve



71901

Later Style Control Valve

a - Pivot Bolt
b - Control Valve

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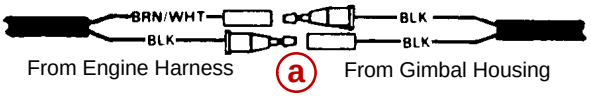
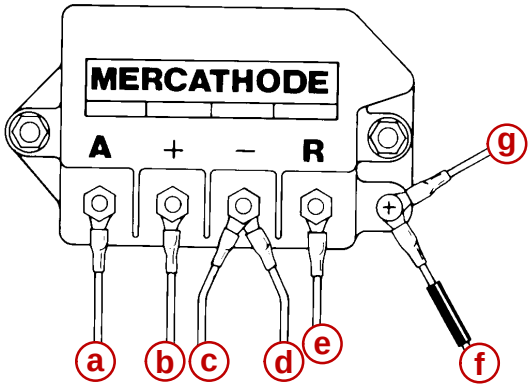
2. Disconnect the trim sender wires.
3. Disconnect MerCathode wires from controller (if so equipped).



24841

Models With Bullet Connectors on Trim Sender Wires

a - Bullet Connectors

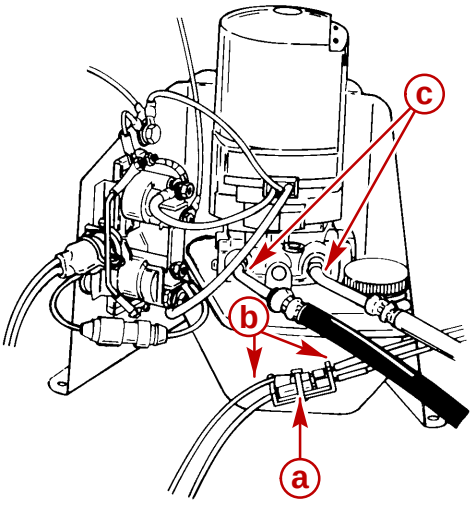


22032

Models With Trim Sender Wire Connections At The MerCathode Controller

a - ORANGE Lead - From Electrode on Transom Assembly
b - RED/PURPLE Lead - Connected (Other End) to Positive (+) Battery Terminal
c - BLACK Lead - From Engine Harness
d - Trim Position Sender Lead
e - BROWN Lead - From Electrode on Transom Assembly
f - Trim Position Sender Lead
g - BROWN/WHITE Lead - From Engine Harness

4. Disconnect gear lube monitor warning horn wires, if so equipped.
5. Remove engine (refer to appropriate engine service manual).
6. Disconnect trim limit switch wires.
7. Remove power trim pump hydraulic hoses and disconnect trim limit switch wires. Cap hoses and plug pump fitting holes.



22031

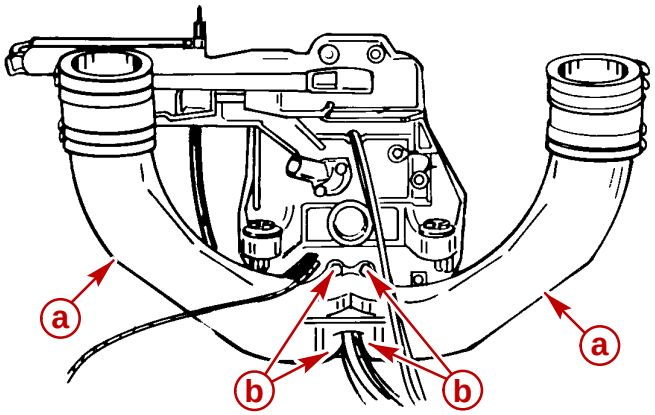
a - Sta-strap
b - Trim Limit Switch Wires
c - Hydraulic Hoses

Index

8. Follow step “a” for models with thru-prop exhaust and step “b” for models with thru-transom exhaust.

   a. **Thru-prop exhaust models:** remove exhaust pipe.

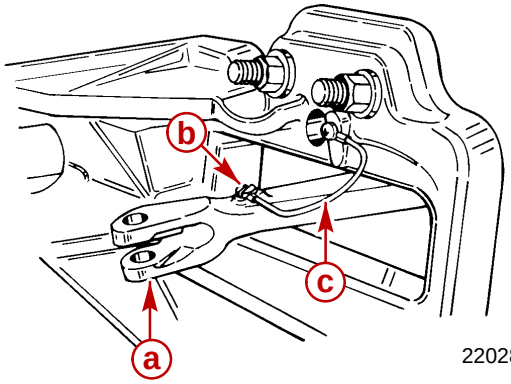
   b. **Thru-transom exhaust models:** it is not necessary to remove the block-off plate unless the gasket/mating surface is leaking or the exhaust system is to be modified (i.e. installing thru-prop exhaust; installing “Silent Choice” system, etc.).



22028

a - Exhaust Pipe
b - Bolts (4)

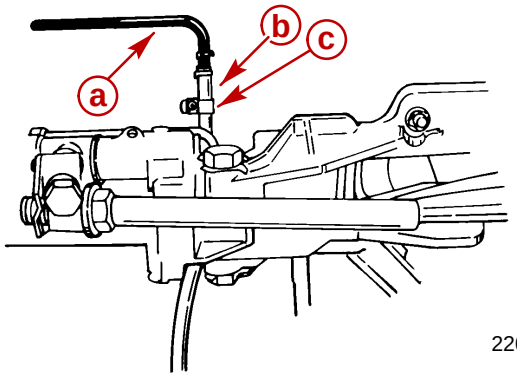
9. Remove the continuity wire from the steering lever.



22028

a - Steering Lever
b - Screw
c - Continuity Wire

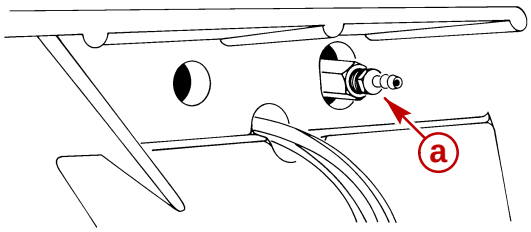
10. Disconnect the speedometer hoses.



22028

Earlier Models

a - Speedometer Hose (From Instrument Panel)
b - Speedometer Hose (From Drive Unit)
c - Mounting Clamp

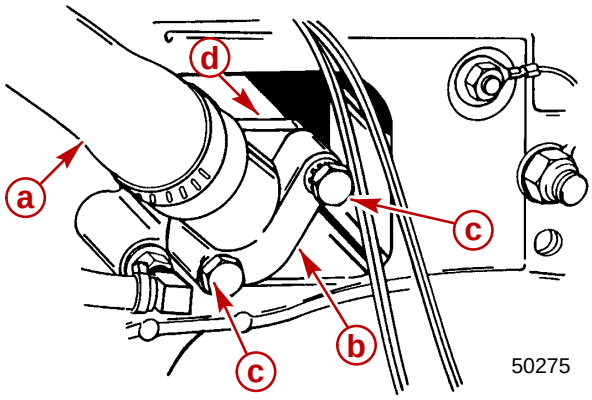


70015

Later Models

a - Speedometer Fitting

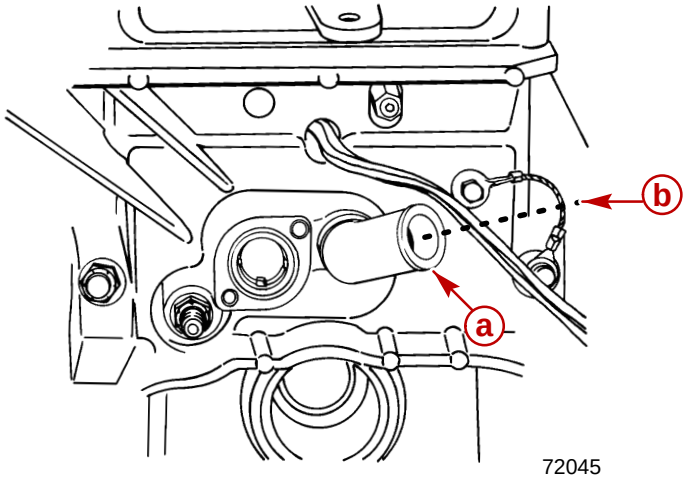
11. Remove seawater intake hose, seawater pickup outlet, and gasket.



50275

a - Seawater Intake Hose
b - Seawater Pickup Outlet
c - Bolts and Star Washers
d - Gasket (Not Visible)

12. **On Diesel Models with Water Bypass Fitting** - Remove fitting.

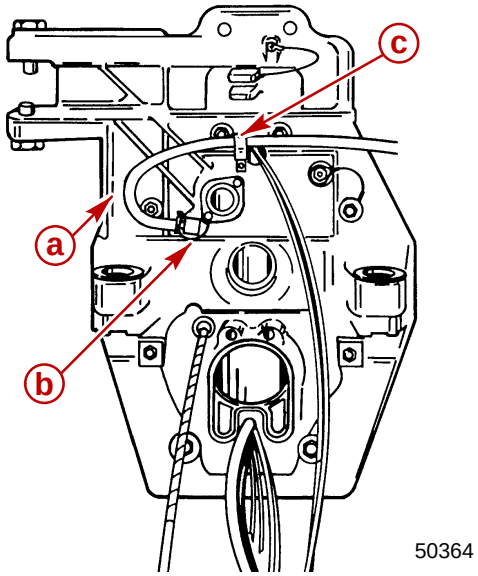


a - Water Bypass Fitting
b - Installed Angle

13. **Models with Gear Lube Monitor:**

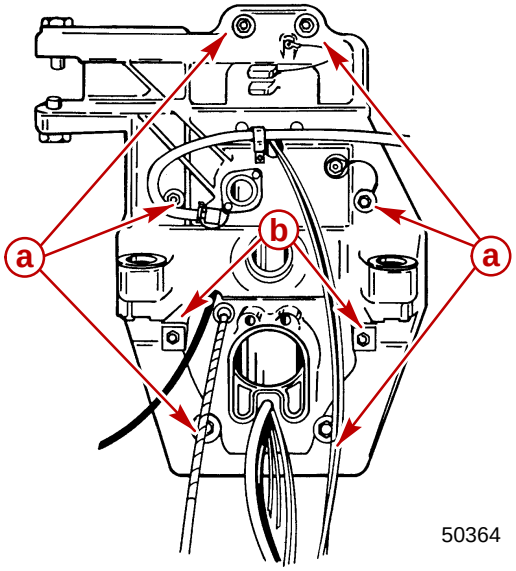
a. Disconnect gear lube monitor warning horn wires from engine harness.

b. Remove gear lube monitor hose, hose clamp, and routing bracket.



a - Gear Lube Monitor Hose
b - Hose Clamp
c - Routing Bracket

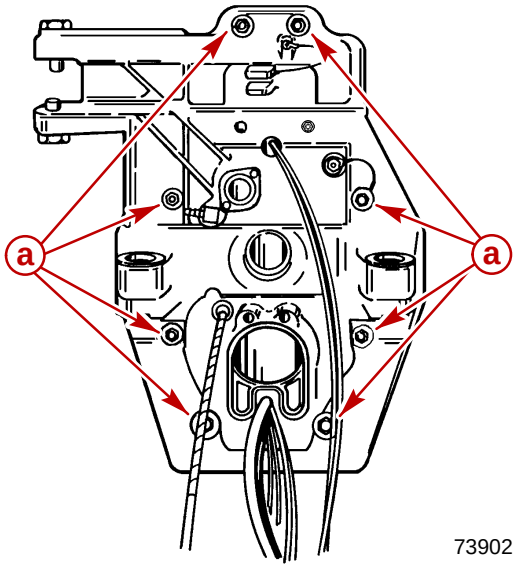
14. Separate the inner transom plate from the gimbal housing assembly.



50364

Earlier Model

a - Locknuts and Washers
b - Bolts and Square Washers



73902

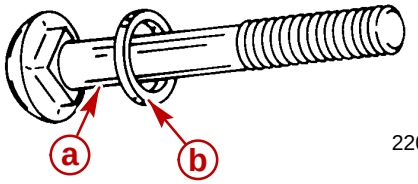
Later Model

a - Locknuts and Washers

Transom Assembly Installation

⚠ CAUTION

Avoid leaks around the carriage head bolts. Rubber seal MUST BE installed on carriage head bolts (if so equipped). Make sure that the rubber seal does not squeeze out beyond the bolt head when installing and tightening the bolt.



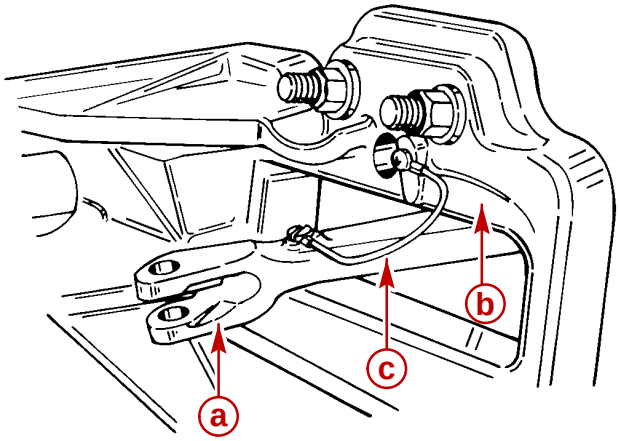
22028

a - Carriage Head Bolt
b - Rubber Seal

IMPORTANT: Torque bolts and nut (or studs and nuts if so equipped) evenly to 20-25 lb. ft. (27-34 N·m). Tighten the center nuts first then work outward.

⚠ CAUTION

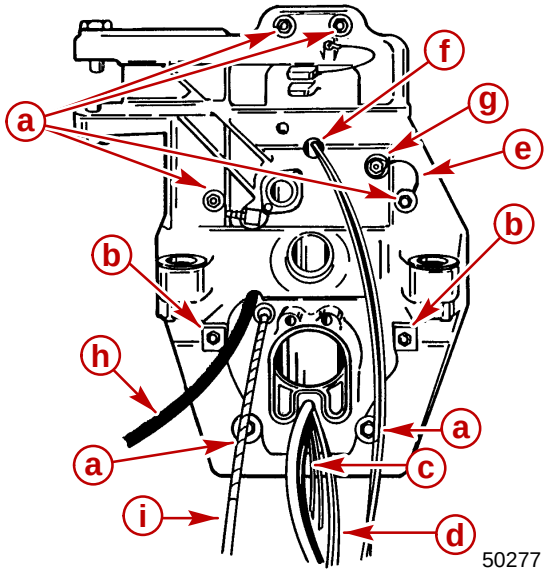
Avoid continuity wire failure. Position the steering lever ground wire as shown or the wire may fatigue and break.



22028

a - Steering Lever
b - Transom Plate
c - Continuity Wire

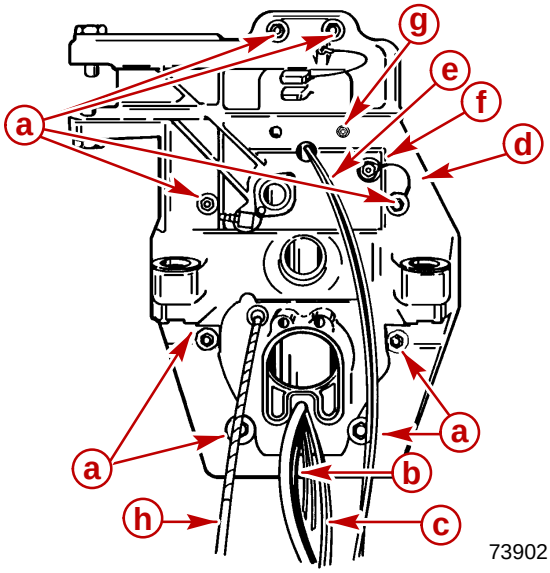
1. Install the transom assembly. Tighten the attaching bolt and nut (earlier models) or studs and nuts (later models) evenly (starting from the center and working outward). Torque to 20-25 lb. ft. (27-34 N·m).



50277

Earlier Model

a - Locknuts and Flat Washers (Securing Carriage Head Bolts)
b - 4-1/4 in (108mm) Long Bolts, LockWashers, and Square Flat Washers
c - Power Trim Hoses
d - MerCathode Wires
e - Continuity Wire
f - Trim Limit and Trim Position Sender Wires
g - Grounding Bolt
h - Speedometer Hose (Earlier Models)
i - Shift Cable



73902

Later Model

a - Locknuts and Flat Washers
b - Power Trim Hoses
c - MerCathode Wires
d - Continuity Wire
e - Trim Limit and Trim Position Sender Wires
f - Grounding Bolt
g - Speedometer Connection
h - Shift Cable

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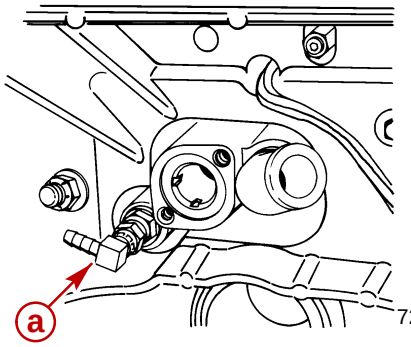
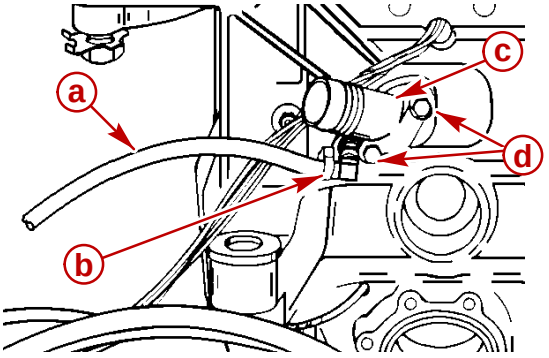
2. **Models with Gear Lube Monitor** - Install 90° hose fitting and position as shown. Torque to 70-90 lb. in. (8-10 N·m).



a - 90° Hose Fitting

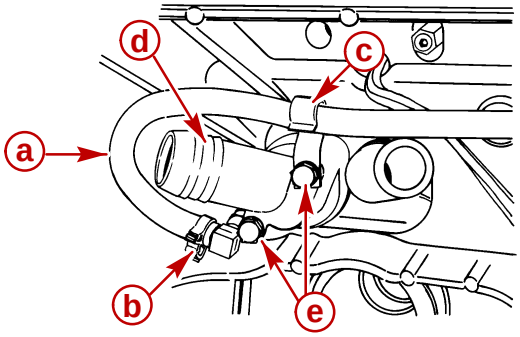
IMPORTANT: Hose must not come in contact with steering system components or the engine coupler and drive shaft.

3. Install water inlet fitting with gasket. Connect gear lube monitor hose (if equipped) to 90° fitting and secure with hose clamp. Torque bolts and star washers to 45 lb. in. (5 N·m).



a - Hose to Gear Lube Monitor
b - Hose Clamp
c - Water Inlet Fitting
d - Bolts and Star Washers

4. **On Some Models with Gear Lube Monitor:** The gear lube hose may be routed toward the port side of the engine. If so, secure the hose at the top side of the water fitting using the hose clip as shown. Torque bolts and star washers to 45 lb. in. (5 N·m).



a - Gear Lube Monitor Hose
b - Hose Clamp
c - Hose Clip
d - Water Hose Fitting
e - Bolts and Star-Washers

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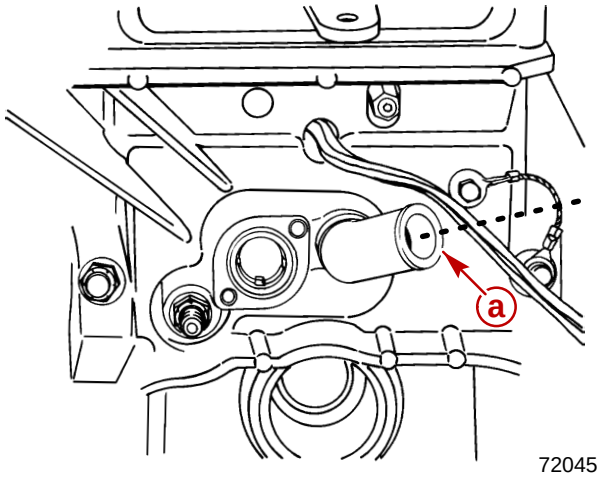
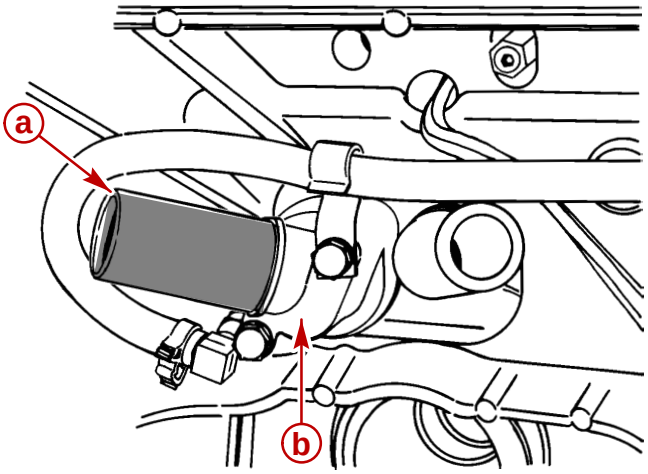
5. **On D7.3L Diesel Models with Water Bypass Fitting** - Apply Perfect Seal to threads and install fitting. Tighten securely and position as shown.



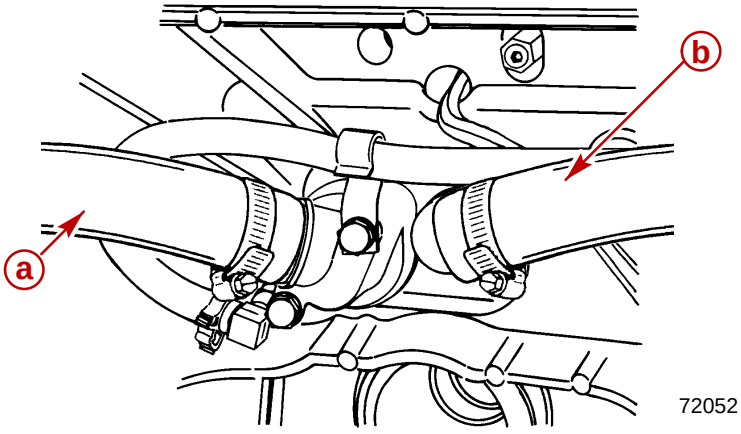
a - Water Bypass Fitting

6. **On D7.3L Models** - Install hose reducer as shown.



a - Hose Reducer
b - Water Inlet Fitting

7. Connect water hoses to appropriate fittings and tighten hose clamps securely.



a - Seawater Hose (To Engine Seawater Pump)
b - Seawater Pickup Hose

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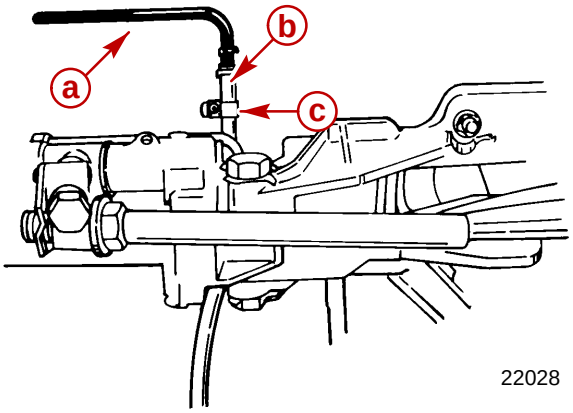
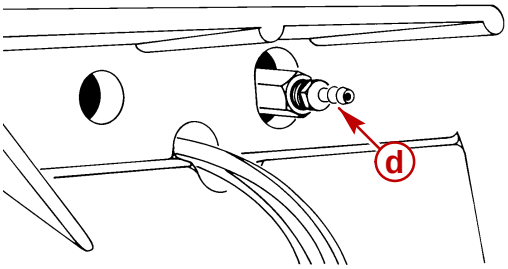
8. Connect the speedometer hose.



22028

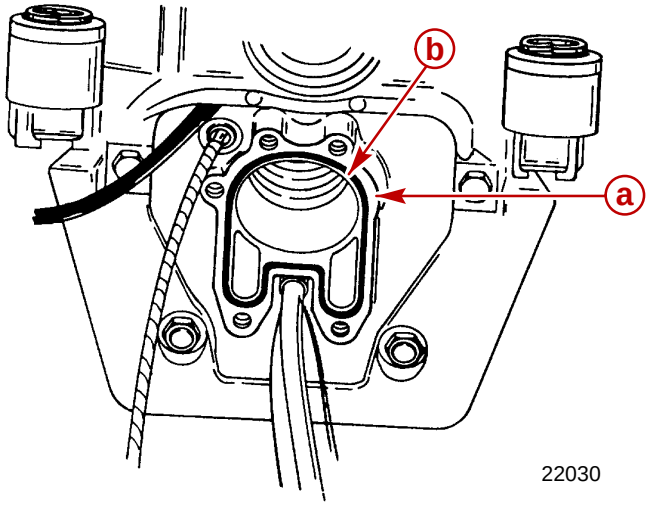


70015

Earlier Models **Later Models**

a - Speedometer Hose (From Instrument Panel)
b - Speedometer Hose (From Drive Unit)
c - Mount Clamp
d - Speedometer Fitting

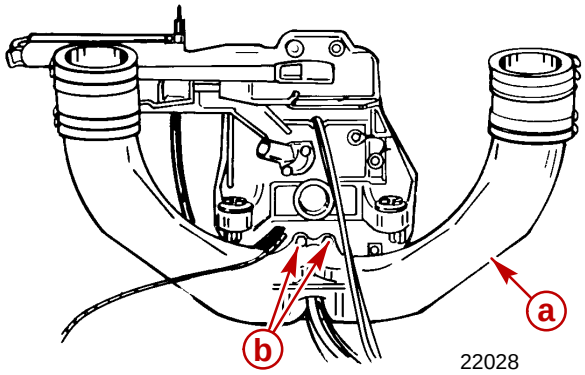
IMPORTANT: Exhaust pipe or block-off plate, and gimbal housing mating surface, must be clean and free of nicks and scratches, and O-ring must be properly seated in groove, or water may leak into boat.



22030

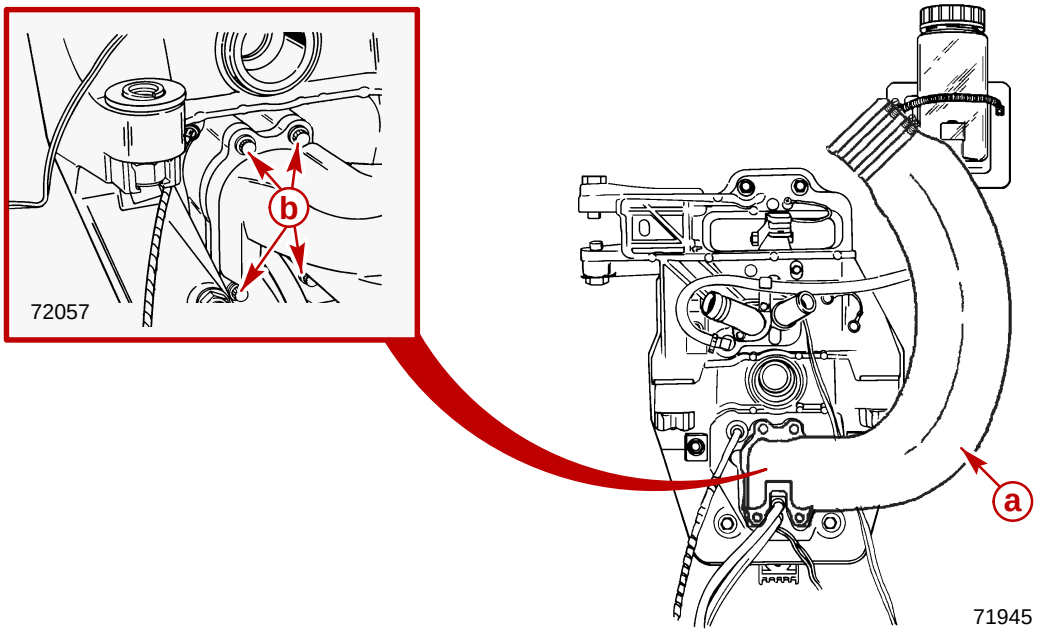
a - Mating Surface
b - O-Ring

9. **Thru-prop exhaust models:** Install exhaust pipe. Torque bolts to 20-25 lb. ft. (27-34 N·m).



Typical V6 and V8 Gasoline Engines

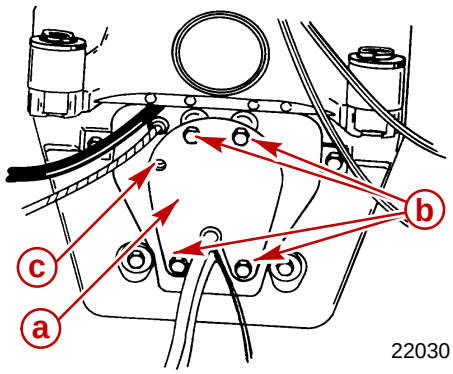
a - Exhaust Pipe
b - Bolts



Typical Diesel Engine

a - Exhaust Pipe
b - Bolts

10. **Thru-transom exhaust models:** Install exhaust block-off plate, if removed. Torque bolts to 20-25 lb. ft. (27-34 N·m).



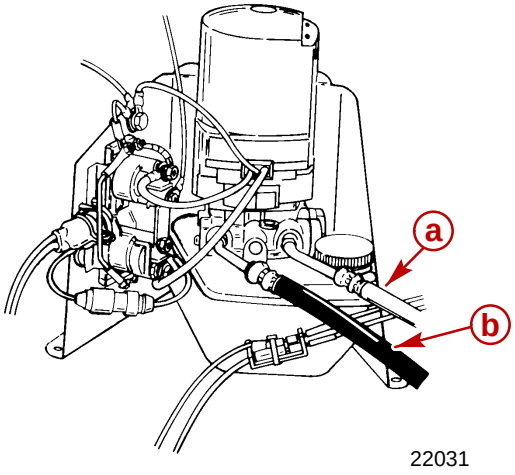
a - Block-off Plate
b - Bolts
c - No Bolt in This Hole on Earlier Models

IMPORTANT: Make hydraulic hose connections as quick as possible to prevent oil from leaking out of the system.

⚠ CAUTION

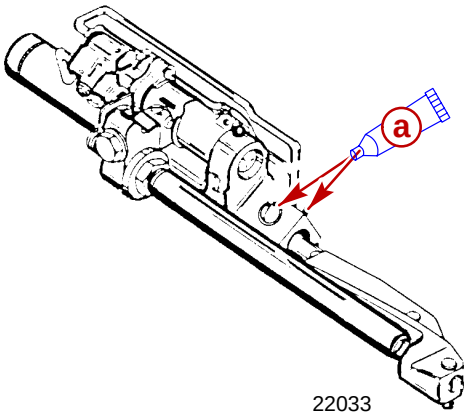
Installing trim pump hoses improperly can damage the hose fittings and cause leaks or loose lines. Do not cross thread or overtighten the hose fittings.

11. Connect the power trim pump hydraulic hoses. Torque both hose fittings to 100-150 lb. in. (11-16 N·m).

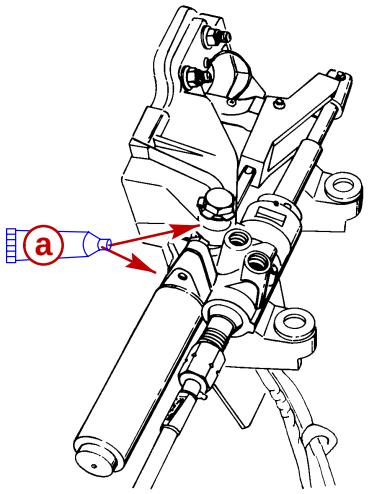


a - “Down” Pressure Hydraulic Line (Grey)
b - “Up” Pressure Hydraulic Line (Black)

12. Install engine (refer to the appropriate engine service manual).
13. Connect the power steering assembly to the transom.
    a. Lubricate bushings with Special Lubricant 101.



22033

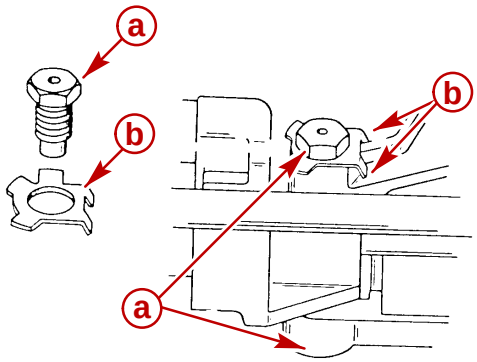


71901

Earlier Style Control Valve **Later Style Control Valve**

a - Special Lubricant 101

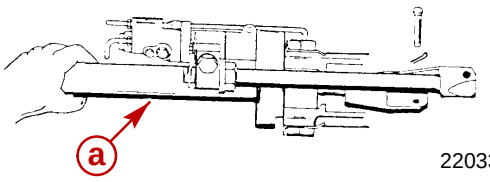
    b. Slide the power steering cylinder bushings between the transom mounting brackets. Tighten the two pivot bolts by hand. At the same time, move the steering assembly slightly to ensure proper pin engagement into the pivot bushings.
    c. Ensure that the washer tangs straddle the ridges on the inner transom plate.



22033

a - Pivot Bolt
b - Washer Tang

    d. Torque the pivot bolts to 25 lb. ft. (34 N·m). Bend the washer tabs against the corresponding flats on both pivot bolt heads.
    e. Make sure the power steering control valve pivots freely.



22033

a - Power Steering Control Valve

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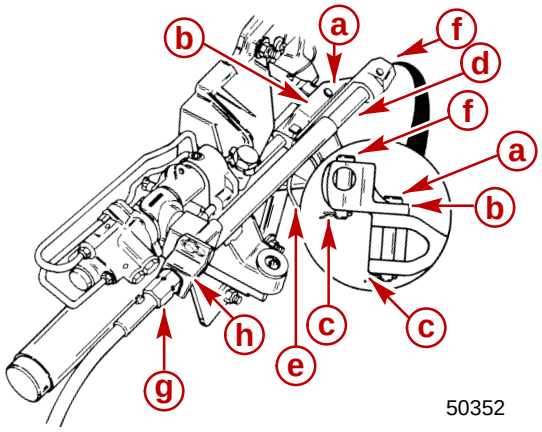
14. Connect the power steering unit to the steering lever.
    a. Lubricate the clevis pins with Special Lubricant 101.
    b. Install the clevis pin in the clevis from the top.
    c. Secure the pin in the clevis with a cotter pin. Speed the cotter pin ends.
15. Lubricate the steering cable end with a liberal amount of Special Lubricant 101 and install the cable through the guide.
16. Connect the cable end to the clevis with the forward clevis pin. Spread the cotter pin ends.
17. Tighten the steering cable coupler nut. Torque to 35 lb. ft. (48 N·m).
18. **Earlier Style Control Valves:** Install locking plate on the coupler nut and secure the coupler nut with a screw and washer. Torque to 60-72 lb. in. (7-8 N·m).

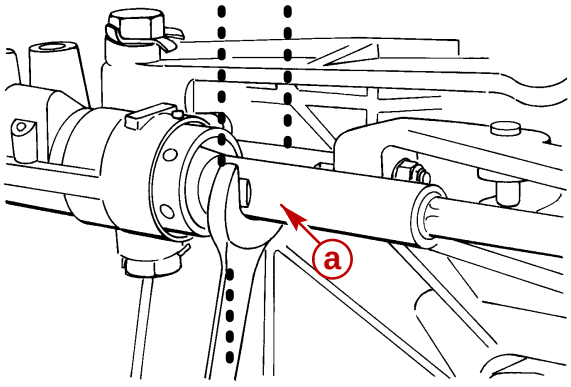


50352

Earlier Style Control Valve

a - Rear Clevis Pin
b - Clevis
c - Cotter Pin
d - Steering Cable End
e - Cable Guide
f - Forward Clevis Pin
g - Coupler Nut
h - Locking Plate

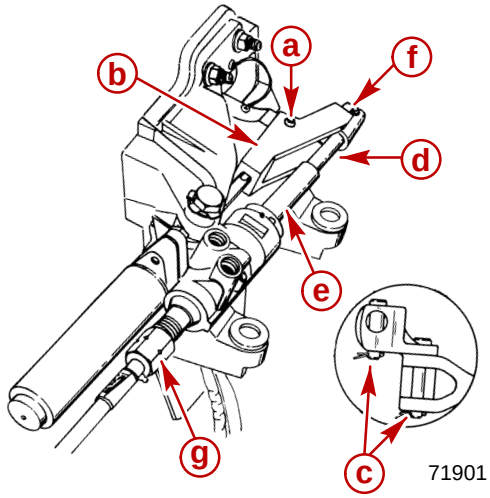
19. **Later Style Control Valves:** Using a suitable wrench hold the flat surfaces on the cable guide tube in the vertical position. Torque coupler nut to 35 lb. ft. (47 N·m). **Be certain the flat surfaces are still aligned vertically after torque is applied to coupler nut.**



73901

a - Flat Surface on Guide Tube

20. **Later Style Control Valves:** Torque the coupler nut to 35 lb. ft. (48 N·m).

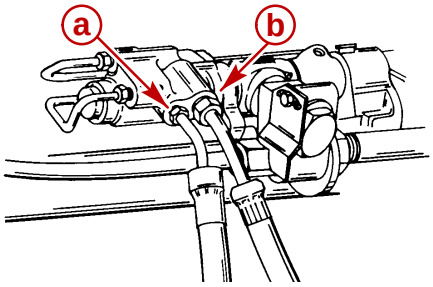


71901

a - Rear Clevis Pin
b - Clevis
c - Cotter Pin
d - Steering Cable End
e - Cable Guide
f - Forward Clevis Pin
g - Coupler Nut

21. Attach both hydraulic hose fittings.

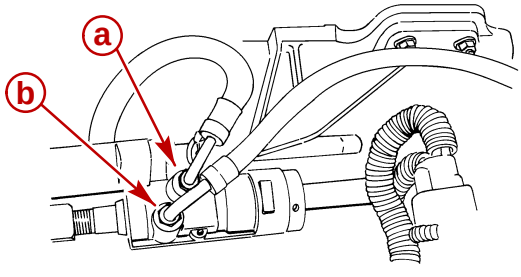
a. **Earlier Style Control Valves:** Torque the large fitting to 23 lb. ft. (31 N·m). Torque the small fitting to 100 lb. in. (11 N·m).



22023

a - Small Fitting
b - Large Fitting

b. **Later Style Control Valve:** Torque both fittings to 23 lb. ft. (31 N·m). Route hoses as appropriate to avoid contact with the steering system components.



73860

Models With One Hose Routed Behind Power Steering Control Valve

a - Rear Hose (Pressure Hose)
b - Front Hose (Return Hose)

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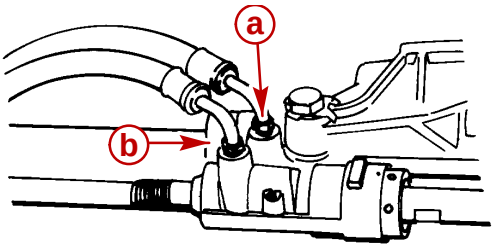
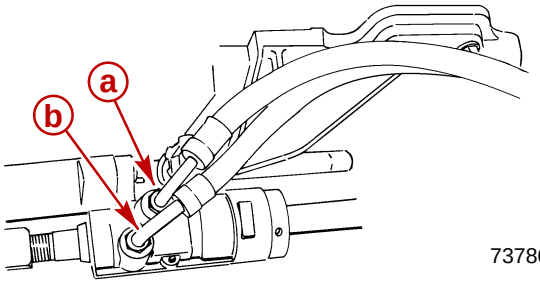


74248

Models With Both Hoses Routed Behind Power Steering Control Valve Toward Starboard Side

a - Rear Hose (Pressure Hose)
b - Front Hose (Return Hose)



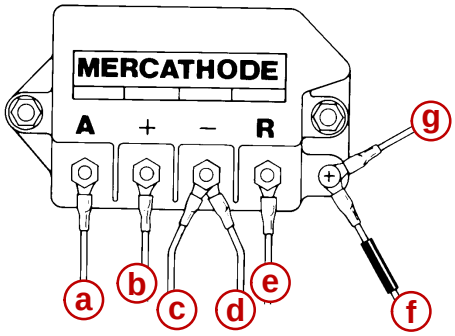
73786

Models With Both Hoses Routed Over Transom Plate

a - Rear Hose (Pressure Hose)
b - Front Hose (Return Hose)

22. Connect trim sender wires and MerCathode

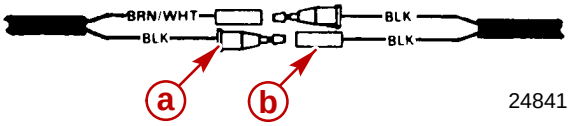
a. **Earlier models with trim the sender wire connection at the MerCathode controller:** Connect the electrical leads.



22032

a - ORANGE Lead - From Electrode on Transom Assembly
b - RED/PURPLE Lead - Connected (Other End) to Positive (+) Battery Terminal
c - BLACK Lead - From Engine Harness
d - Trim Position Sender Lead
e - BROWN Lead - From Electrode on Transom Assembly
f - Trim Position Sender Lead
g - BROWN/WHITE Lead - From Engine Harness

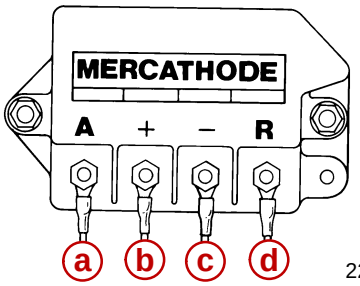
b. **Later Models with trim sender wire/engine harness connection:** Connect the trim sender leads from the gimbal housing to leads from the engine harness.



24841

a - Bullet Connectors - From Engine Harness
b - Bullet Connectors - From Transom Assembly

c. If not already done, connect the MerCathode wires at MerCathode controller.

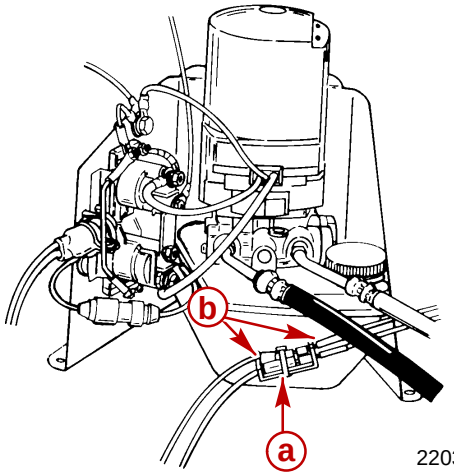


22232

a - ORANGE Lead - From Electrode on Transom Assembly
b - RED/PURPLE Lead - Connect (Other End) to Positive (+) Battery Terminal
c - BLACK Lead - From Engine Harness
d - BROWN Lead - From Electrode on Transom Assembly

23. Apply a thin coat of Liquid Neoprene to all electrical connections.

24. Connect the trim limit switch wires.



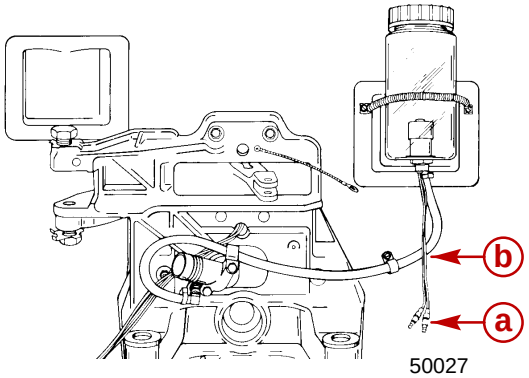
22031

a - Sta-Strap
b - Trim Limit Switch Wires

25. **Models With Transom Mounted Gear Lube Monitor:** Connect the gear lube monitor warning horn wires to the wires from the engine harness.

a. **Gasoline engine models:** Connect wires (TAN/BLUE and BLACK) to matching wires from engine harness (with bullet connectors).

b. **Diesel engine models:** Connect the TAN/BLUE wire to the BLACK/GREEN wire from the engine harness (with bullet connectors). Connect the BLACK wires (with bullet connector).



50027

a - Bullet Connectors
b - Warning Horn Wires

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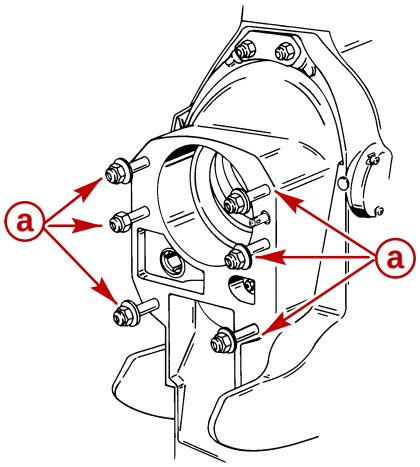
Sterndrive Unit Installation

1. Install and align the engine (refer to the appropriate engine service manual).

NOTE: *If the engine was removed and the shift cable was disconnected, reinstall and adjust the shift cable before proceeding (see page 2A-34).*

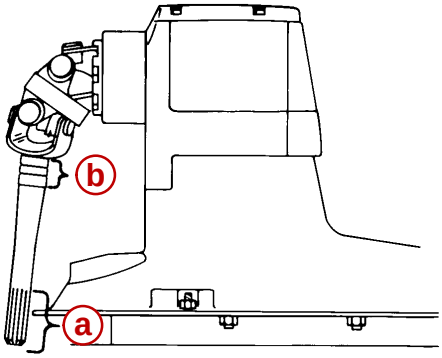
2. Place the remote control shift lever in the neutral position.
3. Lubricate the bell housing studs with 2-4-C Marine Lubricant with Teflon.



24725

a - Bell Housing Studs

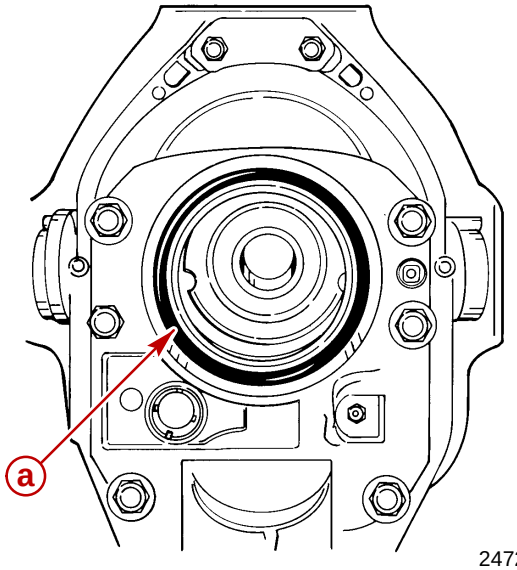
4. Lubricate the U-joint shaft splines and the O-rings with Engine Coupler Spline Grease.



22026

a - U-Joint Shaft Splines
b - U-Joint Shaft O-rings

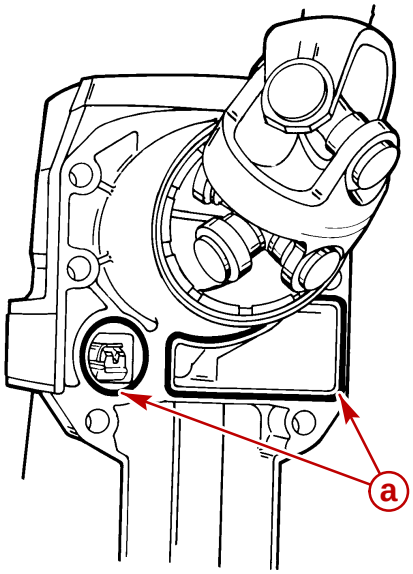
IMPORTANT: The edge of the U-joint bellows acts as a seal between the bell housing and the drive shaft housing. Ensure that the surface is not damaged.



24725

a - Drive Shaft Bellows Edge

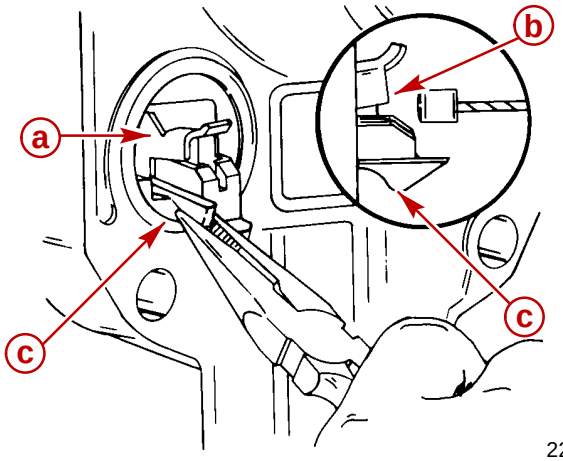
5. Inspect the drive shaft bellows for cracks, nicks, and cleanliness. Replace or clean the bellows as necessary.
6. Lubricate the O-ring seals on the face of the drive shaft housing.



22031

a - O-Ring Seals

7. Pull out the shift linkage as far as it moves. The jaws will open. Lubricate the underside of the lower lip of the shift linkage assembly with Special Lubricant 101.

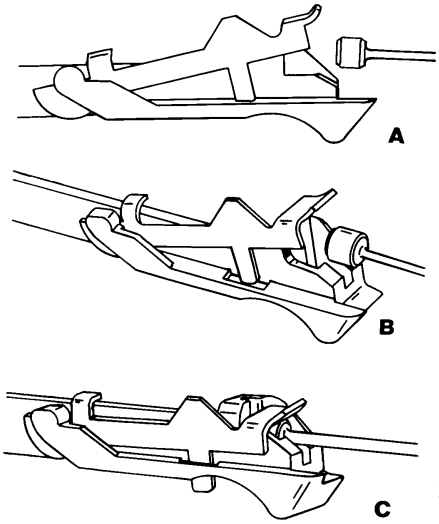


22025

a - Shift Linkage Assembly
b - Jaws - Open
c - Underside of Lower Lip

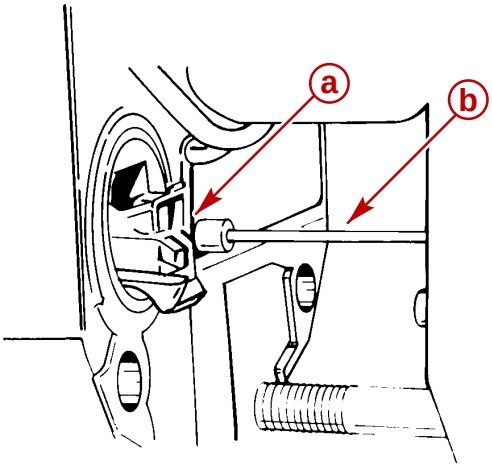
IMPORTANT: As you are inserting the sterndrive unit into the bell housing, the entrance of the bell housing shift cable must be closely checked to ensure that the cable enters the "Jaws" of the shift linkage assembly in the drive unit.

NOTE: *As the shift cable enters the shift linkage assembly, it pushes the assembly back into the drive shaft housing, and the jaw closes, securing the cable as shown in A, B, and C (below).*



22025

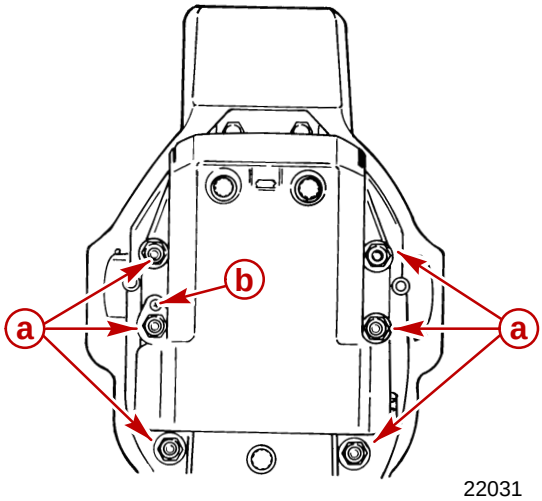
NOTE: *If the shift cable does not line up to properly enter the shift linkage jaws, use your hand to guide the cable into place while installing the sterndrive unit.*



22025

a - Shift Linkage Jaws
b - Shift Cable

8. Install the sterndrive unit.
   a. Position the trim cylinders so that they point straight backwards (aft).
   b. Align the universal joint shaft with the bell housing bore. Make sure the studs on the bell housing align with the appropriate holes on the drive unit.
   c. Guide the U-joint shaft through the gimbal bearing and into the engine coupler. Make sure that the shift linkage jaws engage with the shift cable.
   d. If necessary, rotate the propeller shaft slightly to align the U-joint shaft splines with the engine coupler splines, then slide the drive unit completely into the bell housing.
   e. Rotate the propeller shaft slightly to ensure that the drive unit is still in neutral once installed.
9. Fasten the sterndrive unit to the bell housing. Start from the center and torque the nuts to 50 lb. ft. (68 N·m).



22031

a - Locknuts (6) and Flat Washers(5)
b - Ground Plat (Continuity Washer Not Used Here)

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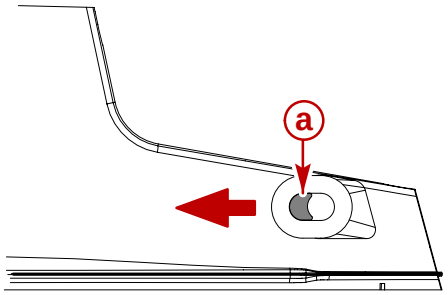
IMPORTANT: On Bravo One, Two, and Three Models, the "Trim-In Limit Spacer" (If equipped), must be properly positioned before installing the trim cylinder anchor pin in the following steps.

NOTE: *Ensure that the Trim-In Limit Spacer is reinstalled in the same position that it was in prior to removal of the sterndrive unit. If you are not sure of it's original position, contact the boat manufacturer for their recommendation. Refer to Special Information at the front of this section before reinstalling the Trim-In Limit Spacer.*

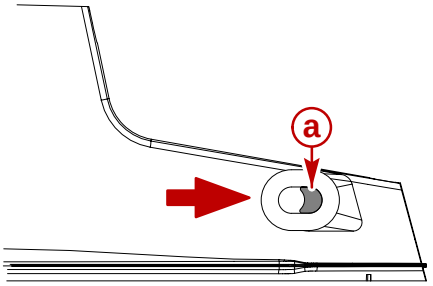
10. If equipped, ensure that the Trim-In -Limit Spacer is positioned as shown for the appropriate Bravo model.



75157

Bravo One and Two (Positioned Forward)

a - Trim-In Limit Spacer



75158

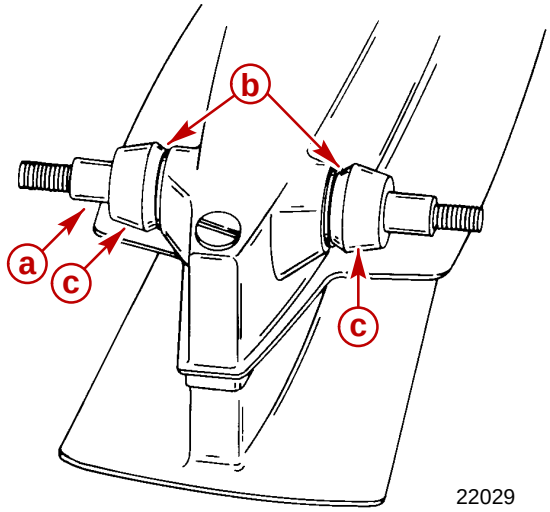
Bravo Three (Positioned Aft)

a - Trim-In Limit Spacer

IMPORTANT: The position of the Trim-In Limit Spacer on the Bravo Three sterndrive unit should only be changed after the boat has been properly tested. Contact the boat manufacturer if you are not sure of the original position for a particular boat application.

IMPORTANT: Use a soap and water solution to aid in installing the rubber bushings.

11. Insert the aft anchor pin through the hole in the drive shaft housing. Then, place a large I.D. flat washer and rubber bushing on each end of the anchor pin. Be sure to install the bushings with the small diameter end facing outward.

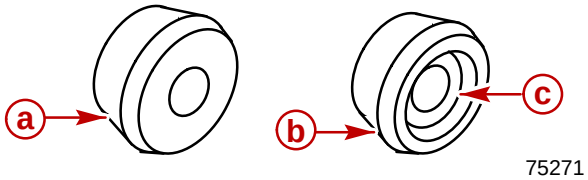


22029

a - Anchor Pin
b - Large I.D. Washers
c - Rubber Bushings

12. Loosen the nuts which secure the trim cylinders to the forward anchor pins. Move the cylinder pivot ends outward and place them over the aft anchor pin.

NOTE: *The bushings on Later Bravo drive units are made from a different type of material. The later style is harder. The bushing can also be identified by a small indentation on the outside face of the bushing. Do not mix the earlier style rubber bushings with the later style.*

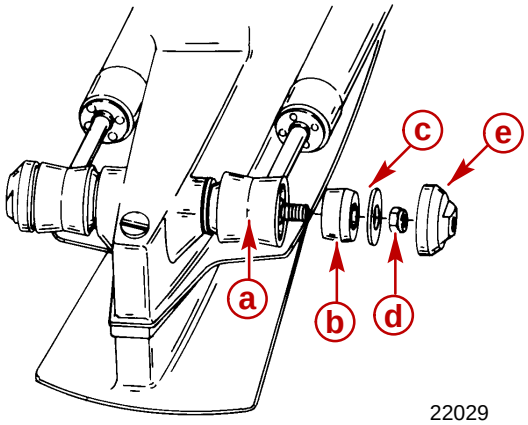


75271

a - Earlier Style Bushing
b - Later Style Bushing
c - Indentation on Later style

13. Place the rubber bushings (with the smaller diameter end facing inward) and the small I.D. flat washers onto each end of the anchor pin. Install plastic stop nuts.
14. Tighten the forward and aft anchor pin nuts until the nuts and washers bottom out against anchor pin shoulder.

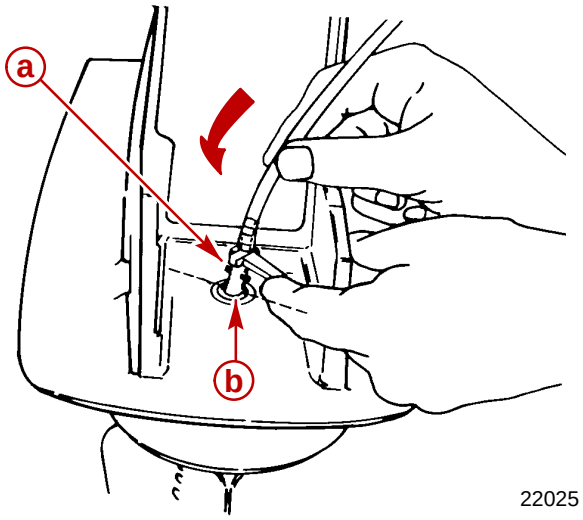
15. Attach the trim cylinder caps. Hand tighten only. If the caps will not catch the threads, recheck the tightness of the anchor pin nuts.



22029

a - Trim Cylinder Pivot Ends
b - Rubber Bushing
c - Small I.D. Flat Washer
d - Locknut
e - Trim Cylinder Cap

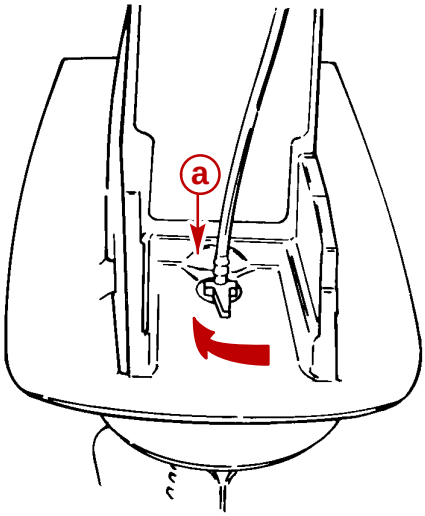
16. Attach the speedometer hose fitting to the sterndrive unit.
    a. Raise the drive unit to gain access to the area between the gimbal housing and the drive unit and locate the opening in the forward end of the anti-ventilation plate.
    b. Insert the speedometer hose fitting into the opening.



22025

a - Speedometer Hose Fitting
b - Opening

c. With the fitting fully seated, turn the handle clockwise to a tightly seated position.



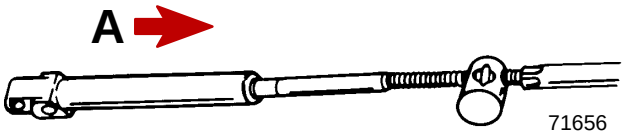
22025

a - Fitting Installed (Handle Pointing Forward)

Shift Cable Installation and Adjustment

NOTE: *Using Adjustment Tool (91-12427), shift cables can be adjusted without or with the sterndrive installed, using the following procedure.*

IMPORTANT: Front propeller on <u>Bravo Three</u> drive unit is always LH rotation and rear propeller is always RH rotation. Shift cable end guide must move in direction A, when control lever is placed in Forward gear position.

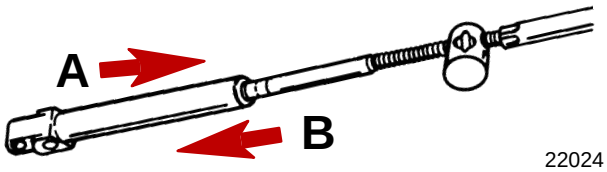


71656

BRAVO THREE

IMPORTANT: <u>For Bravo One and Two:</u> Drive unit propeller rotation is determined by the shift cable installation in the remote control.

- **If shift cable end guide moves in direction “A,” when control lever is placed in Forward, remote control is setup for RIGHT HAND (RH) propeller rotation.**
- **If shift cable end guide moves in direction “B,” when control lever is placed in Forward, remote control is setup for LEFT HAND (LH) propeller rotation.**



22024

BRAVO ONE AND TWO

IMPORTANT: When installing shift cables, be sure that cables are routed in such a way as to avoid sharp bends and/or contact with moving parts. DO NOT fasten any items to shift cables.

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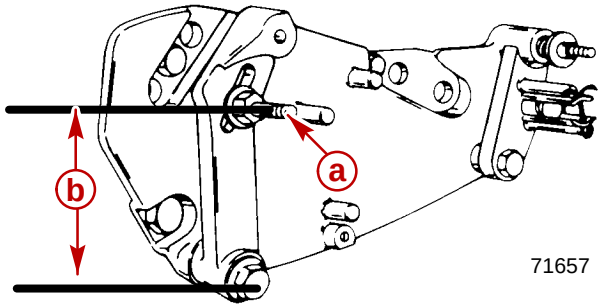
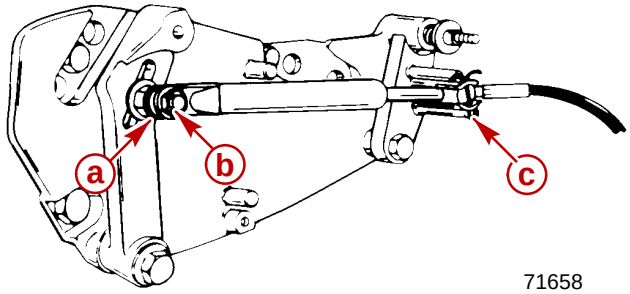
1. Install shift cable into remote control. Refer to remote control manufacturer's instructions.
2. Loosen stud and move it to dimension, as shown. Retighten stud.



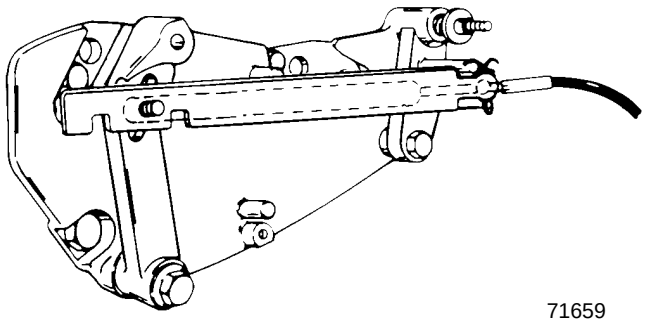
a - Stud
b - 3 Inches (Center of Pivot Bolt to Center of Stud)

3. Install drive unit shift cable.



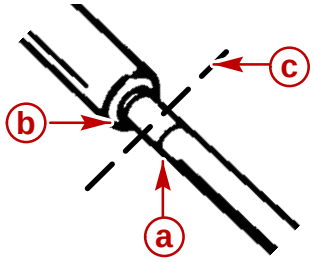
a - Washers (2)
b - Locknut-Tighten Until Contact, Then Loosen 1 Turn
c - Cotter Pin-Insert from Top and Spread Both Ends

4. Place adjustment tool over drive unit shift cable, as shown. Hold tool in place over the barrel retainer with a piece of tape.



5. Locate center of remote control and control cable play (backlash).
   a. Shift remote control to neutral.
   b. Push in on control cable end with enough pressure to remove play, and mark position "a" on tube.
   c. Pull out on control cable end with enough pressure to remove play and mark position "b" on tube.

d. Measure distance between marks “a” and “b.” Then, mark position “c” half-way between marks “a” and “b.”



71656

IMPORTANT: Be sure to keep center mark “c” aligned with control cable end guide edge when making the following adjustment.

6. Adjust control cable as follows:

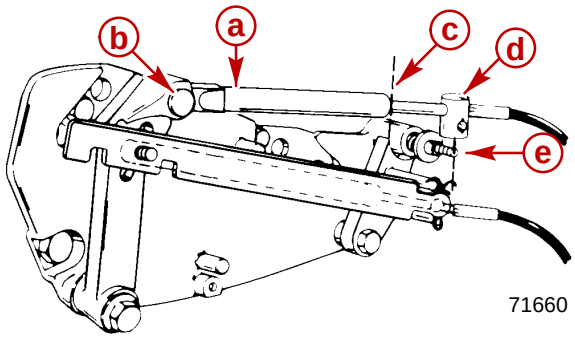
   a. Temporarily install control cable end guide into shift lever and insert anchor pin.

   b. Adjust control cable barrel so that hole in barrel centers with vertical centerline of stud. Ensure that backlash center mark is aligned with edge of control cable end guide.

⚠ CAUTION

DO NOT attempt to install or remove control cable barrel from stud, without first removing end guide anchor pin from shift lever, and removing cable. Attempting to bend control cable to install or remove barrel, will place undue stress on cable end guide and shift lever, and damage to both could occur.

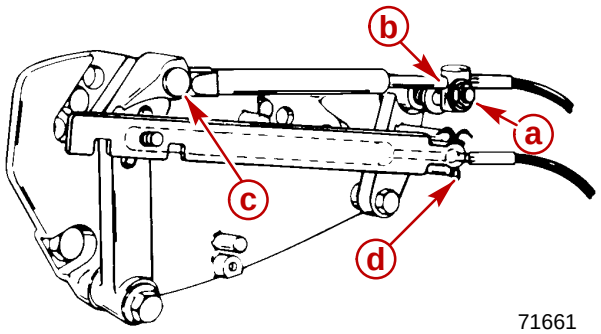
   c. Remove control cable end guide from shift lever, by removing anchor pin.



71660

a - Control Cable End Guide
b - Anchor Pin
c - Backlash Center
d - Control Cable Barrel
e - Stud

7. Install control cable. Tighten locknut until it bottoms out. Spread both ends of cotter pin.



71661

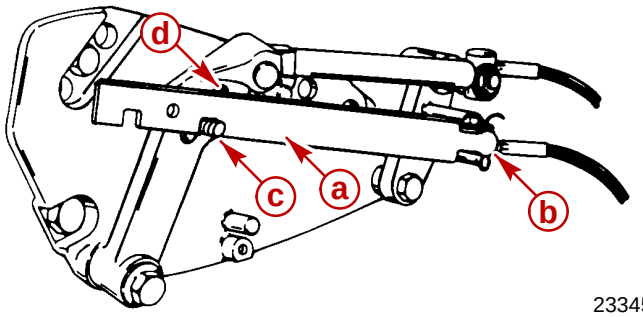
a - Locknut
b - Washers-Both Sides of Barrel
c - Anchor Pin
d - Cotter Pin

8. Remove adjustment tool.
9. Shift remote control lever into full forward position. Rear slot in tool should fit over shift lever stud.

RH ROTATION BRAVO ONE AND TWO, AND ALL BRAVO THREE MODELS: Rear slot in tool should fit over shift lever stud.

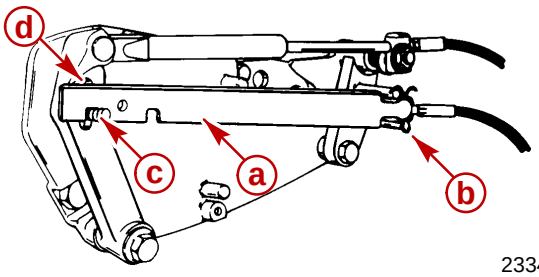
LH ROTATION BRAVO ONE AND TWO MODELS: Forward slot in tool should fit over shift lever stud.

If slot does not fit over stud, loosen shift lever stud and slide stud up or down, until slot in tool fits over stud. When adjustment is correct, retighten stud.



23345

RH Rotation Bravo One And Two, And All Bravo Three Models



23345

LH Rotation Bravo One And Two Models

a - Adjustment Tool
b - Barrel Retainer
c - Shift Lever Stud
d - Shift Lever Adjustment Slot

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10. Remove adjustment tool.

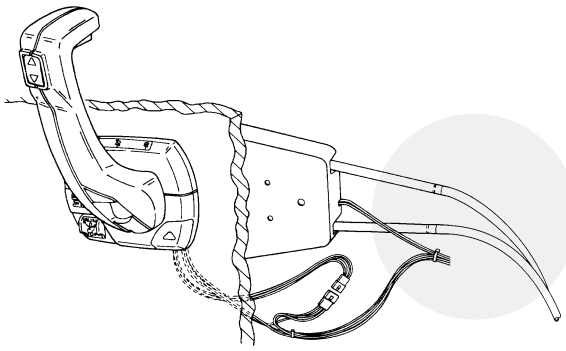
11. Lubricate shift cable pivot points with 30W oil.

Troubleshooting Shift Problems

NOTE: *The following information is provided to assist an installer in troubleshooting, if hard shifting or chucking/racheting is encountered when shifting into forward gear.*

1. When installing the control box in the side panel of the boat, make sure that the cables have enough clearance to operate. This is necessary because the cables move up and down when the shift handle is moved. If the control box is mounted too far back towards any fiberglass structure, the cables will be interfered with, this will cause very hard shifting.

NOTE: *The control box housing can be rotated in 30° increments to improve cable routing.*



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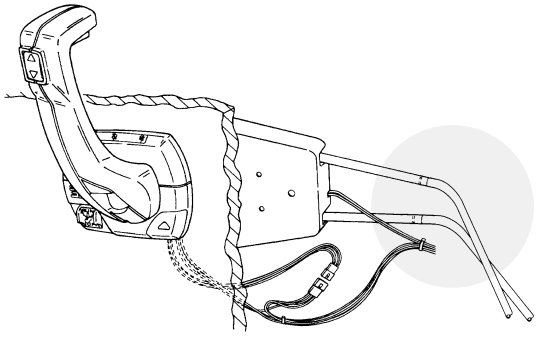
Proper Cable Bend



74689

Improper Cable Bend

2. Make sure that when the shift cable from the control box is lead through the side gunnel of the hull, that it does not have any extremely sharp bends in it as this will cause the stiff shifting.

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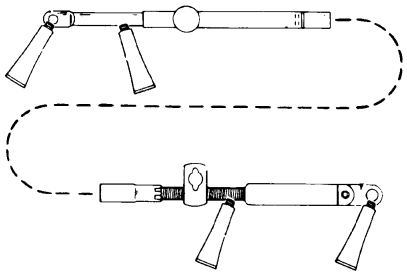
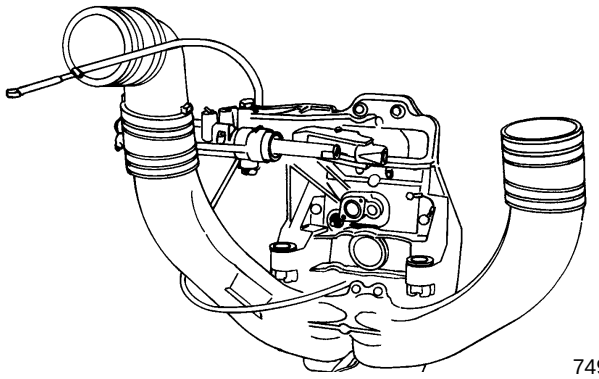
3. Before installing the shift cable into the control box, extend the stainless rod eye end of the cable and grease it with 2-4-C Marine Lubricant with Teflon. Move it back and forth to allow even distribution of the grease.



22005

4. Do not strap or clamp the control cables to any other cables or rigid structure within **three feet** of the control box.
5. Be sure the cable is not permanently kinked.
6. Make sure there is proper clearance for cable movement when the control box is installed in the side panel. The cables must have room to move up and down when the control handle is shifted into either forward or reverse.
7. Check to make sure that the engine was not set down on the intermediate shift cable during installation, as this will crush the inner cable tubing and cause improper and / or stiff shifting.
8. DO NOT fasten the shift cable with straps or clamps to any other cable within **five feet** of the shift plate.
9. DO NOT fasten the shift cable to the transom with any type of plastic clips or fasteners within **five feet** of the shift plate.
10. DO NOT overtighten the throttle or shift cable attaching nuts at the engine end. Barrel and cable end must be free to rotate on the mounting stud.
11. Check the intermediate shift cable routing from the transom assembly to the shift plate as follows:
    a. The cable should come through the transom, above the exhaust pipe and make a turn towards the starboard side of the boat between the exhaust pipe and the engine flywheel housing.
    b. The cable should then be routed under the starboard rear engine mount, and turn towards the transom.
    c. Then go up behind the power steering valve and loop over to the shift plate on the engine, where it is connected to the anchor points on the shift plate.

Following this routing will prevent the engine coupler from damaging the cable.



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STERNDRIVE UNIT

Section 3A - Drive Shaft Housing

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3 A

Specifications

Torque Specifications

DESCRIPTION	TORQUE		
	lb. in.	lb. ft.	N·m
Shift Cam Assembly Locknuts	80		9
U-joint Bearing Retainer Nut		200	271
Shift Cam Assembly to Shifter Shaft Screw	110		13
Shift Linkage to Shifter Shaft, Screw	110		13
Top Cover Screws		20	27
Back Cover Screws		20	27
Drive Shaft Housing to Gear Housing Nuts and Screw		35	32
Trim Tab or Anodic Plate Screw		23	32
Oil Vent Plug	30-50		3.4-5.6

Special Tools

Description	Part Number
Torque Wrench (lb. in.)	91-66274
Slide Hammer Puller	91-34569A1
U-joint Bearing Retainer Wrench	91-17256
Clutch Assembly Stand	91-17301A1
Shift Handle Tool	91-17302
Bearing Removal Tool	91-17273
Bearing and Seal Driver Assembly	91-17275A1
Bearing Driver	91-89868
Driver and Puller Assembly	91-90244A1
U-joint Press Adaptor	91-38756
Universal Puller Plate	91-37241

Bearing Preloads

DESCRIPTION	TORQUE	
	lb. in.	N·m
U-joint Bearings (New)	6-10	.7-1.1
U-joint Bearings (Used)*	3-6	.4-.7

* Bearings are used if spun once under load.

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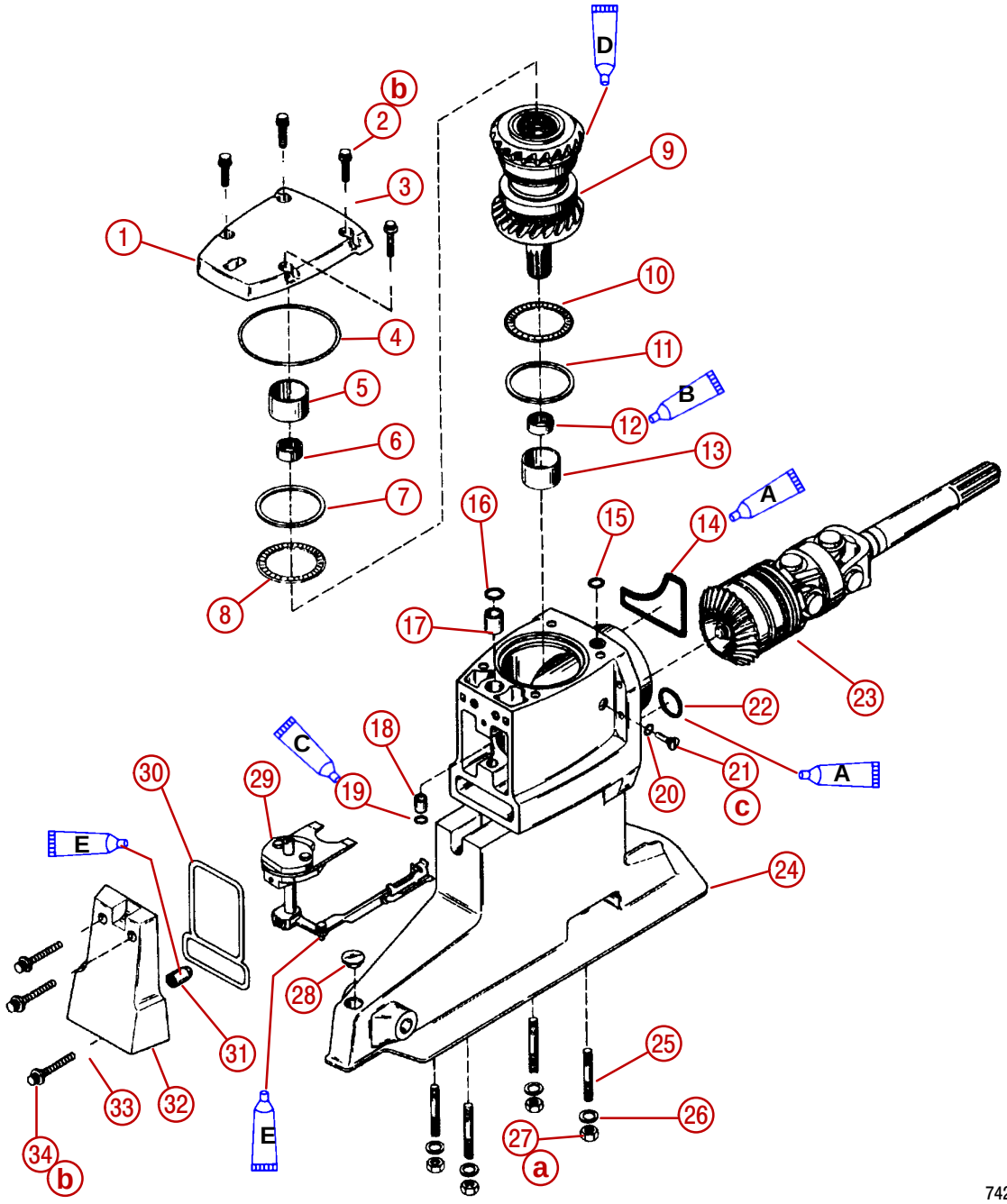
Lubricants/Sealers/Adhesives

Description	Part Number
Quicksilver 2-4-C Marine Lubricant with Teflon	92-825407A2
3M Brand Adhesive	92-86166-1
Quicksilver Needle Bearing Assembly Lubricant	92-825265A1
Quicksilver Perfect Seal	92-34227-1
Quicksilver Special Lubricant 101	92-13872A1
Quicksilver High Performance Gear Lube	92-816026A1
Quicksilver U-Joint and Gimbal Bearing Grease	92-828052A2
Permalock 115	Obtain Locally
Loctite 27131	91-809820

Drive Shaft Housing Exploded View

Complete Housing



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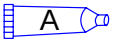
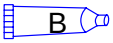
1 - Top Cover
2 - Screw (4)
3 - Flat Washer (4)
4 - O-ring
5 - Bearing Sleeve
6 - Needle Bearing
7 - Thrust Race (Shim)
8 - Thrust Bearing
9 - Clutch Assembly
10- Thrust Bearing
11- Thrust Race (shim)
12- Needle Bearing
13- Bearing Sleeve
14- O-ring
15- O-ring
16- O-ring
17- Shifter Shaft Bushing-Upper
18- Shifter Shaft Bushing-Lower
19- Shifter Shaft Seal
20- Vent Plug Seal
21- Vent Plug
22- O-ring
23- U-joint Assembly
24- Drive Shaft Housing
25- Stud (4)
26- Flat Washer (4)
27- Locknut (4)
28- Plastic Plug
29- Shifter Assembly
30- O-ring
31- Ball Detent Canister
32- Back Cover
33- Flat Washer (3)
34- Screw (3)

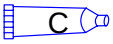
Lubricants/Sealers/Adhesives



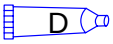
- 3M Brand Adhesive 92-86166-1



- Quicksilver Needle Bearing Assembly Lubricant 92-825265A1

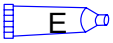


- Loctite 271 92-809820



- Quicksilver High Performance Gear Lube 92-816026A4

(Use On All Bearing Surfaces)



- Quicksilver Special Lubricant 101 . . . . . 92-13872A1

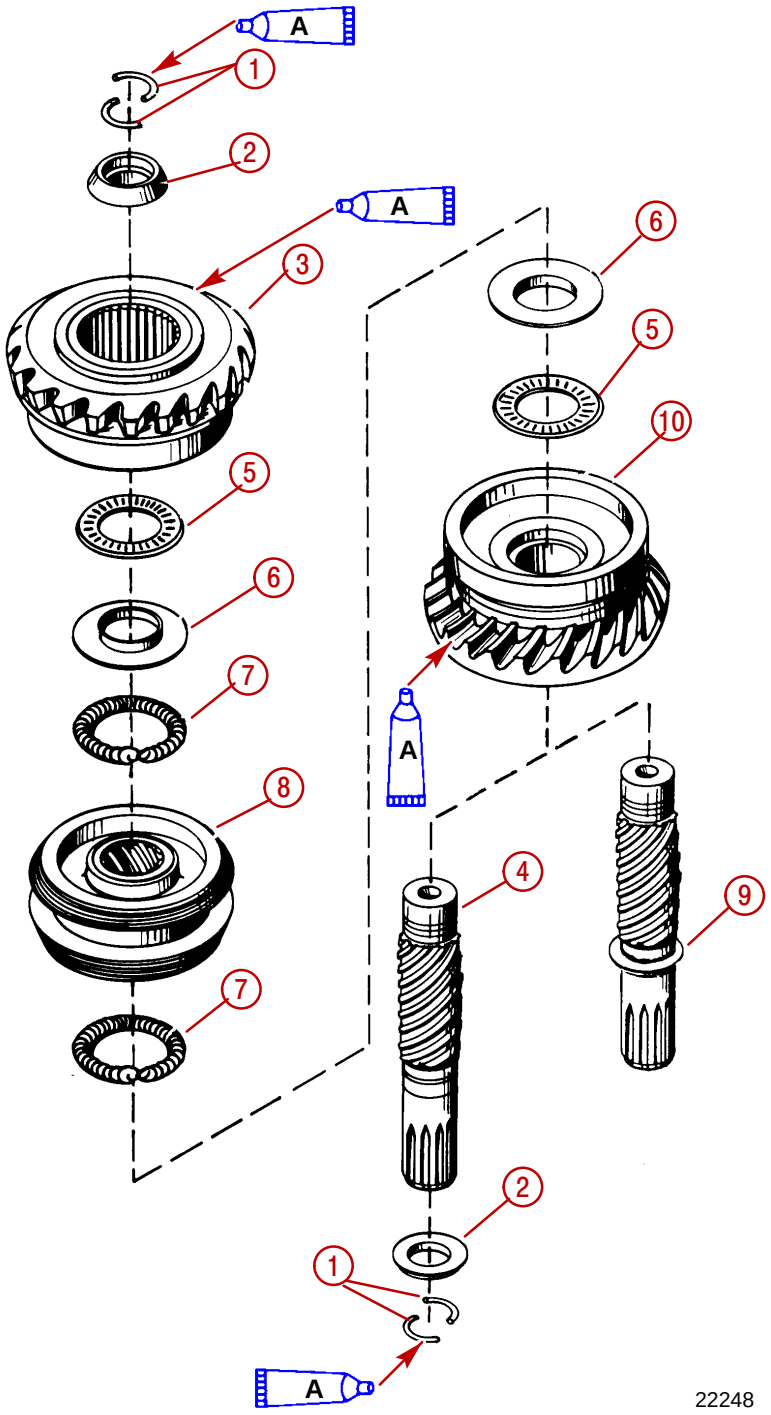
Torque Specifications

(a) . . . . . 35 lb. ft. (47 N·m)

(b) . . . . . 18-22 lb. ft. (25-29 N·m)

(c) . . . . . 30-50 lb. in. (3.4-5.6 N·m)

Exploded Parts View (Clutch)



1 - Keepers
2 - Thrust Collar
3 - Upper Gear Assembly
4 - Earlier Style Shift Shaft (Uses Removable Bottom Thrust Collar With Keepers)
5 - Thrust Bearing
6 - Thrust Race
7 - Garter Spring
8 - Clutch
9 - Later Style Shaft (Bottom Thrust Collar is part of the shaft, No Keepers Used)
10- Lower Gear Assembly

Lubricants/Sealers/Adhesives

A - Quicksilver High Performance Gear Lube 92-816026A4

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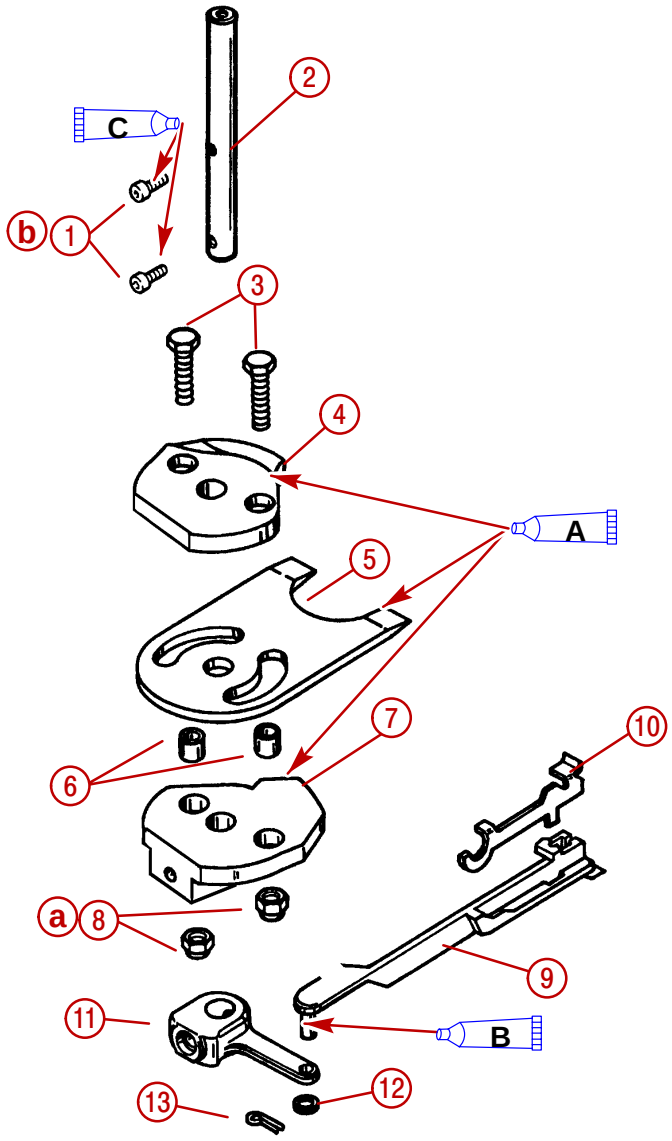
Exploded Parts View (Shifter)



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1 - Socket Screws
2 - Shifter Shaft
3 - Screws
4 - Upper Shift Cam
5 - Yoke
6 - Spacers
7 - Lower Shift Cam
8 - Locknuts
9 - Link Bar
10- Latch
11- Shift Lever
12- Flat Washer
13- Cotter Pin

Lubricants/Sealers/Adhesives

A - Quicksilver High Performance Gear Lube 92-816026A1

B - Quicksilver Special Lubricant 101 . . . . . 92-13872A1

C - Permalock 115 . . . . . Obtain Locally

Torque Specifications

a - 100 lb. in. (11.3 N·m)
b - 110 lb. in. (13 N·m)

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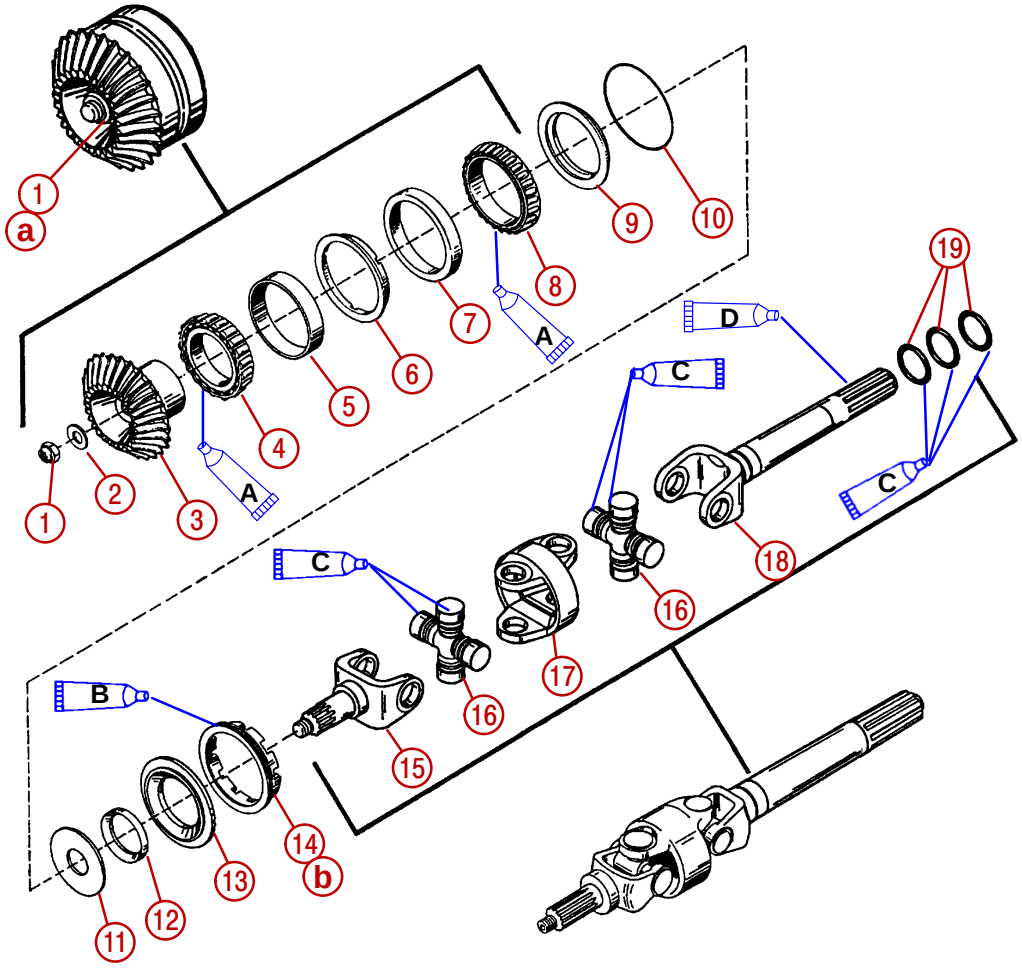
U-Joint Assembly



73364

1 - Locknut
2 - Washer
3 - Pinion Gear
4 - Bearing (Smaller OD)
5 - Bearing (Smaller ID)
6 - Spacer
7 - Bearing Cup (Larger ID)
8 - Bearing Larger OD)
9 - Sealing Ring
10- O-Ring
11- Beveled Washer
12- Oil Seal
13- Oil Seal Carrier
14- Ring Nut
15- Yoke
16- Cross and Bearing
17- Socket
18- Yoke
19- O-rings (3)

Lubricants/Sealers/Adhesives

A - Quicksilver High Performance Gear Lube 92-816026A4

B - Quicksilver Special Lubricant 101 . . . . . 92-13872A1

C - Quicksilver U-joint and Gimbal Bearing Grease 92-828052A2

D - Engine Coupler Spline Grease 92-816391A4

Rolling Preload Specification

a - Tighten in Small Increments Until 6-10 lb. in. (.7-1.1 N·m) of Rolling Preload

Torque Specifications

b - 200 lb. ft. (271 N·m)

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Drive Shaft Housing and Gear Case Separation

Drive Unit Gear Ratio Identification

All drive unit gear ratios are identified on each drive in two places. It is important to note the ratio of the drive unit before proceeding with any repairs. The first place to look is on the decal on the port side of the drive housing. It will have a number such as (1.50R) and then the seal number. The second place to look will be on the universal joint splined yoke. It will be identified with a letter such as (F). This method is explained in the following chart. This will be true for new or un-tampered with drive units. A drive unit could have had the gear ratio changed for high altitude, which would void out any application of the following charts. The gear ratio then would have to be determined by counting the teeth on the drive gear and the driven gear in the drive shaft housing and using the following charts for reference.

Bravo One

U-JOINT IDENTIFICATION

RATIO	U-JOINT SHAFT MARKING
1.65:1	C
1.50:1	F
1.36:1	H

NUMBER OF TEETH PER GEAR - DRIVE SHAFT HOUSING

RATIO	DRIVE	DRIVEN
1.65:1	23	30
1.50:1	27	32
1.36:1	27	29

Bravo Two

U-JOINT IDENTIFICATION

RATIO	U-JOINT SHAFT MARKING
2.20:1	C
2.00:1	F
1.81:1	H
1.65:1	T

NUMBER OF TEETH PER GEAR - DRIVE SHAFT HOUSING

RATIO	DRIVE	DRIVEN
2.20:1	23	30
2.00:1	27	32
1.81:1	27	29
1.65:1	27	32
1.50:1	27	29

Bravo Three

U-JOINT IDENTIFICATION

RATIO	U-JOINT SHAFT MARKING
2.43:1	N
2.20:1	K
2.00:1	B
1.81:1	G
1.65:1	C
1.50:1	F
1.36:1	P

NUMBER OF TEETH PER GEAR - DRIVE SHAFT HOUSING

RATIO	DRIVE	DRIVEN
2.43:1	23	30
2.20:1	23	30
2.00:1	27	32
1.81:1	27	29
1.65:1	27	32
1.50:1	27	32
1.36:1	27	29

Bravo Drive/Unit Housing Comparison And Identification

CHANGES

The latest production and service replacement housings will have an internal casting change to allow for an oil recirculation system on all 1991 and newer Bravo drive units, both Bravo One and Bravo Two models. The oil recirculation is unique in that it causes the oil for the lower gear case to flow up through the drive shaft housing to the universal joint pinion gear bearing set.

Oil also pumps up into the top cover and returns to the lower gear case from the back side of the drive shaft housing through the lower drive shaft needle bearing to the gear case. Besides improving lubrication this oil movement helps the drive unit run cooler.

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IDENTIFICATION

1. **DRIVE SHAFT HOUSING:** The upper drive shaft housing can be identified by looking at the number that is cast into the exhaust cavity face on the front of the housing as shown in the following illustrations.
2. **GEAR HOUSING:** The lower gear case housing can be identified by looking at the number that is cast in front of the trim tab screw on the top inside surface of the housing.

DRIVE SHAFT HOUSING

When ordering an empty replacement upper drive shaft housing or an upper drive shaft housing complete, look at the exhaust cavity in the front of the housing as shown in the drawings on the following pages for the casting numbers to reference the following information:

On the early style Bravo One and Bravo Two drive shaft housings you will find casting numbers (1589-8867C) or (1589-8867C2) or (1589-8867C3) [Figure 1-2]. The proper service replacement number for an empty housing is (1589-8868A15); this housing will have the letter (S) machined into the housing in the exhaust cavity just above the casting number [Figures 3-4].

When ordering a complete upper drive housing assembly with the gears and bearings, etc. already installed order the following part number (1589-8868A14) for a (1.50:1) Bravo One and a (2.00:1) Bravo Two or a (1589-8868A21) for a (1.36:1) Bravo One and a (1.81:1) Bravo Two. These complete assemblies will also have the letter (D) machined into the housing just above the (1589-8867) casting number in the exhaust cavity.

On the 1991 and newer drive shaft housings the casting number in the exhaust cavity will be (1589-8867C5) only [Figures 5-6].

The proper service replacement number for an empty housing is (1589-8868A25). When ordering a complete upper housing assembly with the gears and bearings, etc. installed order the following part number (1589-8868A27) for a (1.50:1) Bravo One and a (2.00:1) Bravo Two or a (1589-8868A29) for a (1.36:1) Bravo One and a (1.81:1) Bravo Two.

GEAR HOUSING

If ordering an empty gear housing or a gear housing complete, look into the cavity just in front of the trim tab screw inside of the gear case as shown in the drawings on the following pages. In these locations, you will find the casting numbers reference information.

On early style 1990 and prior Bravo One gear housings the casting numbers will be (1656-8865C) or (1656-8865C1) [Figures 7-8]. When ordering a service replacement housing only [Figures 9-10] the correct part number to order is (1656-8866A11).

If ordering a complete service gear case assembly that includes all the gears, bearings and shafts, the following part number must be ordered (1656- 8866A10) [Figure 9-10].

On all 1991 and newer Bravo One empty gear housings the casting numbers will be (1656-8865C2) [Figures 11-12]. When ordering an empty housing only the part number is (1656-8866A17). When ordering a gear housing assembly complete including the gears, bearings and shafts, part number (1656-8866A15) must be ordered [Figures 11-12].

On early style 1990 and prior Bravo Two gear housings, the casting numbers will be (1641-8293C) or (1641-8293C1) [Figures 13-14]. When ordering a service replacement housing only, the correct part number to order for the (1641-8293C) housing only is (1641-8294A8). The correct part number to order for the (1641-8293C) housing only is (1641-8294A8). The correct part number for the (1641-8293C1) housing only is (1641-8294A9).

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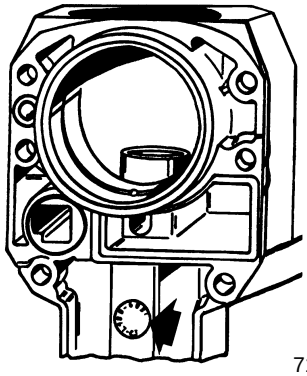
If ordering a complete service gear case assembly that includes all the gears/bearings/and shafts for casting number (1641-8293C) or (1641-8293C1) the following part number must be ordered (1641- 8294A7) [Figure 15-16].

On all 1991 and newer Bravo Two empty gear housings the casting number will be (1641-8293C3). When ordering a gear housing assembly complete including the gears/ bearings and shafts the following part number must be ordered (1641-8294A14) [Figure 17-18].

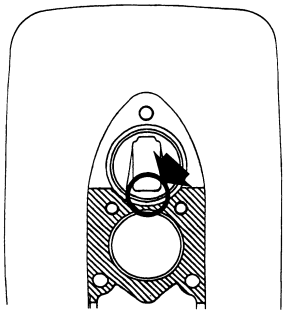
1990 and Prior Drive Shaft Housing

1. Look for the casting number in the area indicated by the arrow. The letters C/CZ/C3 are at the end of the casting number.



71224

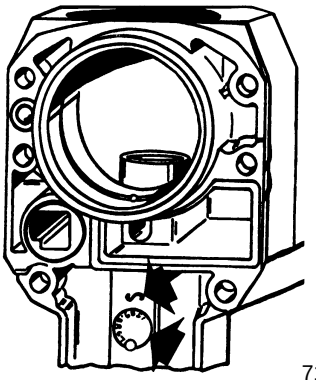
2. The circled area on the housing indicated with an arrow indicates an older style housing.



71187

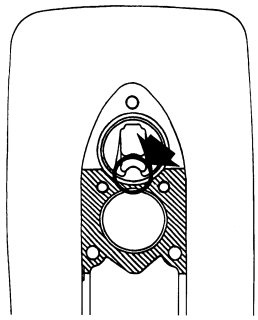
Service Replacement for 1990 and Prior

1. The service replacement housing will have the casting number only and the letter (“S”) machined into the housing just above the casting number. It is the service replacement for the C/C2/ and the C3 early style housings.



71225

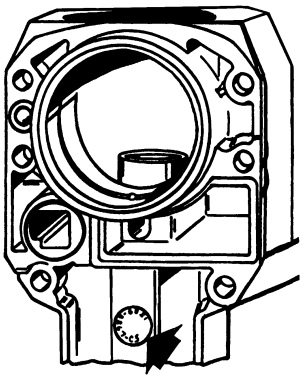
2. The circled area on the housing indicated with an arrow shows where the change took place.



71189

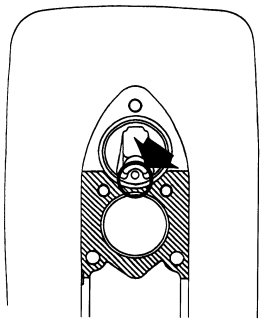
1991 and Newer Drive Shaft Housing

1. Look in the area indicated by the arrow for the casting number, for the 1991 drive unit, the casting number will have a “C5” after the number.



71226

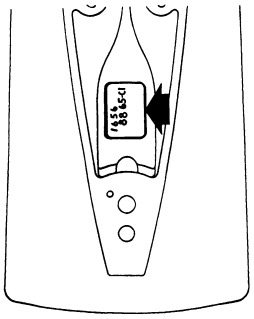
2. The circled area on the housing indicated by an arrow shows where the change took place.



71188

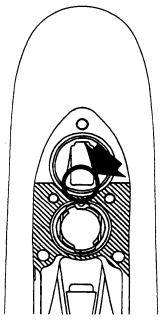
Bravo One 1990 and Prior Gear Housing

1. Look in the area indicated by the arrow for the casting number. The letters after the casting number will be one of the following “C” or “C1”.



71190

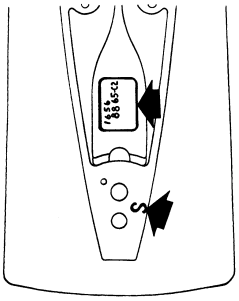
2. The circled area on the housing indicated by an arrow shows the older style housing.



71191

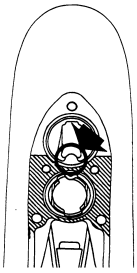
Bravo One Service Replacement for 1990 and Prior

1. Look for the area casting number in the area indicated by the arrow. The letters will be “C2” also the housing will have a letter (“S”) machined into the mating surface of the gear case between the trim tab hole and the aft attaching bolt hole.



71193

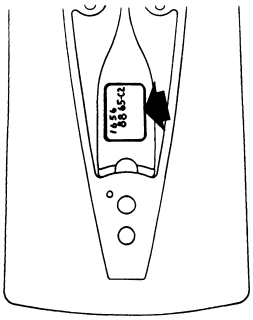
2. The circled area on the housing indicated by an arrow shows where the change took place.



71192

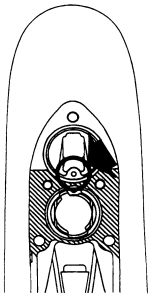
Bravo One 1991 and Newer Gear Housing

1. Look in the area indicated by the arrow for the casting number. It will have a “C2” after the casting number.



71194

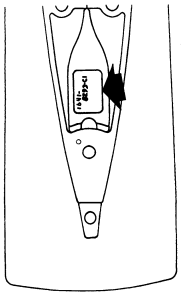
2. The circled area on the housing indicated by an arrow shows where the change took place.



71195

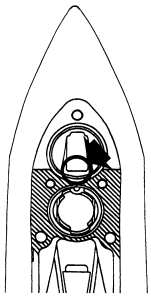
Bravo Two and Prior Gear Housing

1. Look in the area indicated by the arrow for the casting number. The letters after the casting number will be one of the following “C” or “C1”.



71196

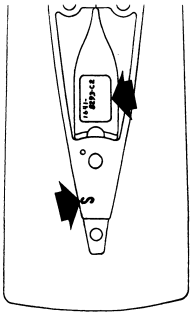
2. The circled area on the housing indicated with an arrow shows the older style housing.



71197

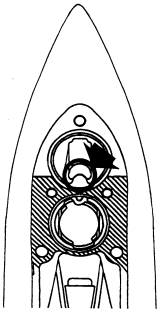
Bravo Two Service Replacement for 1990 and Prior

1. The casting number will have “C2” at the end and the letter (“S”) will be machined into the mating surface of the gear case just behind the aft attaching bolt hole.



71198

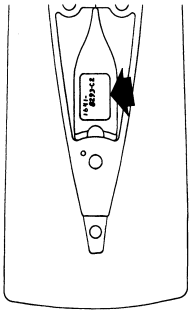
2. The circled area indicated by an arrow shows where the change took place.



71199

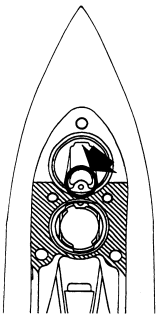
Bravo Two 1991 and Newer Gear Housing

1. The Bravo Two for 1991 and newer will have a “C2” after the casting number.



71200

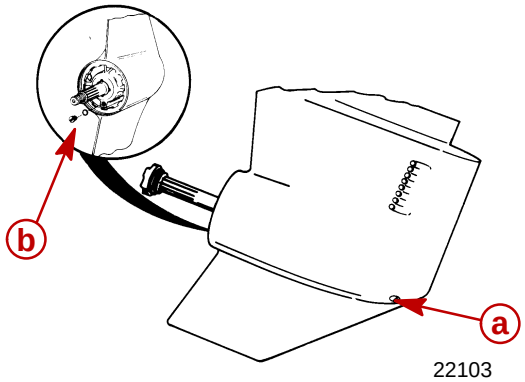
2. The circled area on the housing indicated by an arrow shows where the change took place.



71201

Separate Housings

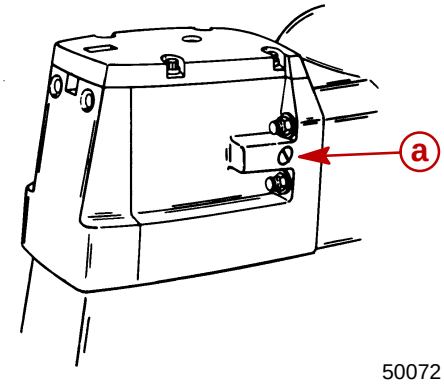
1. **Gear Lube Monitor Models:** remove, empty and clean gear lube monitor. Lubricate neck O-ring seal with gear lube before replacing cap.
2. Drain drive unit at location “a” or “b,” as applicable, by removing fill/drain screw.



22103

a - Fill/Drain Screw
b - Fill/Drain Screw

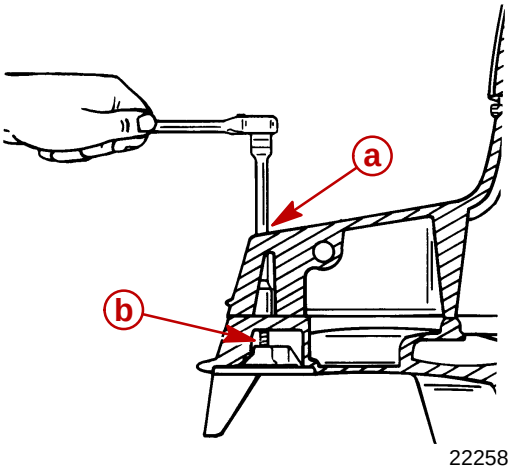
3. Remove vent plug.



50072

a - Vent Screw

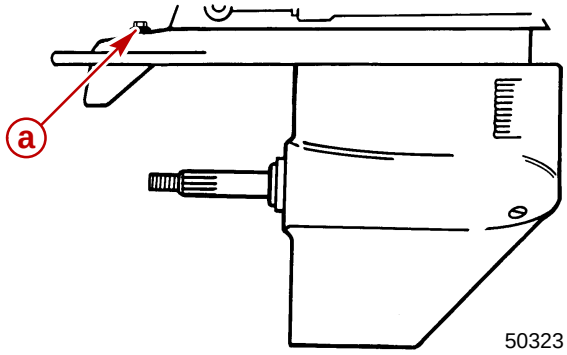
4. **Bravo One Model:** Remove trim tab or anodic plate.



22258

a - Plastic Plug
b - 1/2 in. Bolt

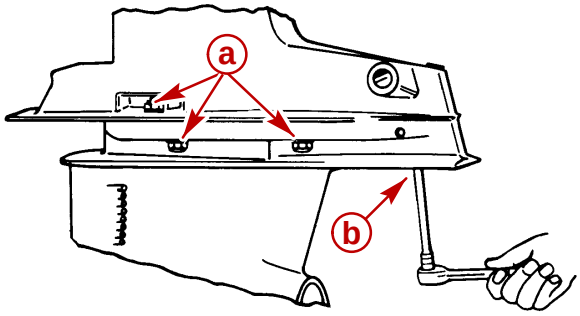
NOTE: On Bravo Two Models: *If working only on drive shaft housing, it is not necessary to remove Bravo Two trim tab.*



Bravo Two Model

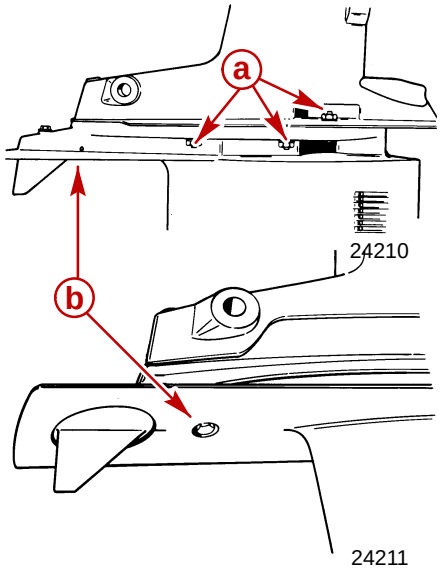
a - 1/2 in. Bolt

5. Remove gear case from drive shaft housing.



Bravo One Model

a - 6 Nuts and Washers (3 Each Side)
b - Bolt (Located in Trim Tab Cavity)



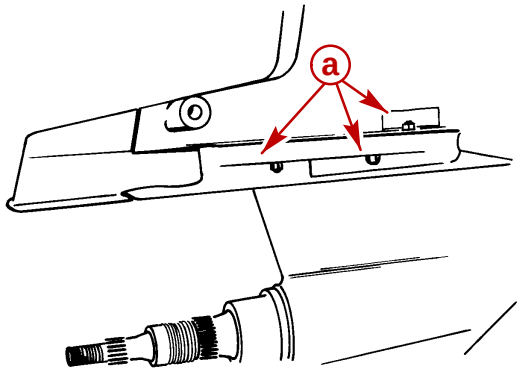
Bravo Two Model

a - 6 Nuts and Washers (3 Each Side)
b - Bolt (Located in Front of Trim Tab)

NOTE: *Later Bravo Three drive units have the splash plate incorporated into the gear housing.*

6. **On Earlier Bravo Three Models:** Perform the following steps.

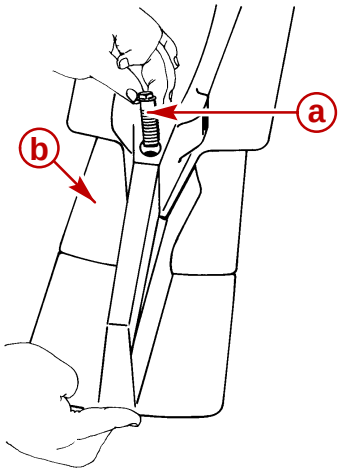
   a. Remove the locknuts and flat washers.



71803

a - Locknuts and Flatwashers (6)

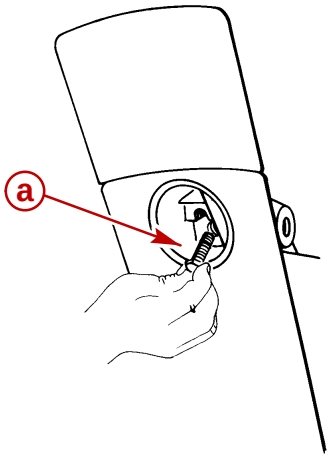
   b. Remove the plastic cap to gain access to the anode attaching bolt. Remove the bolt.



71804

a - Bolt
b - Splash Plate Extension

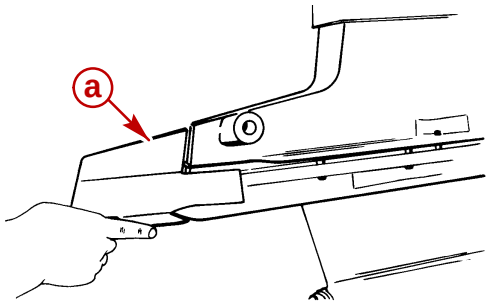
   c. Remove the bolt in the anode cavity.



71805

a - Bolt

d. Slide the splash plate extension away from the slot in the drive shaft housing. Lift the drive shaft housing up and away from the gear housing.



71802

a - Splash Plate Extension

7. Finish draining gear case by turning upside down over container.

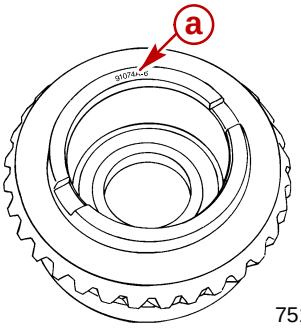
Special Information - Latest Changes to Gear Assembly, Cone Clutch and Shifter Assembly

Gear, Clutch and Shifter Kits 43-807436A1, 43-807437A1, 43-807438A1

For Use on Bravo Sterndrive Units With Serial Numbers 0D764579 and Below

IMPORTANT: The replacement parts in this kit must be used together. DO NOT mix any of your older style existing parts with parts from this kit. Also, if drive unit has previously been serviced with these latest style parts, individual parts can be ordered for replacement.

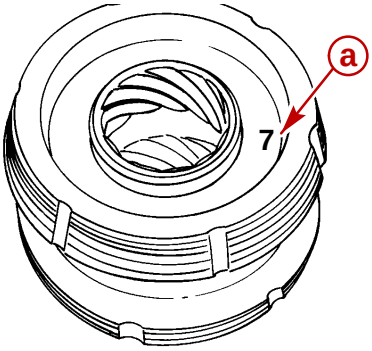
The latest style gears in this kit are identified by the part number being stamped on the gear.



75138

a - Part Number

The latest style cone clutch in this kit is identified by the number “7” stamped in one end of the clutch.

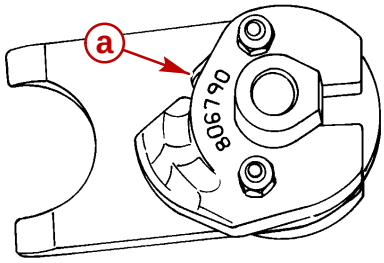


75140

a - Identification Number “7”

Index

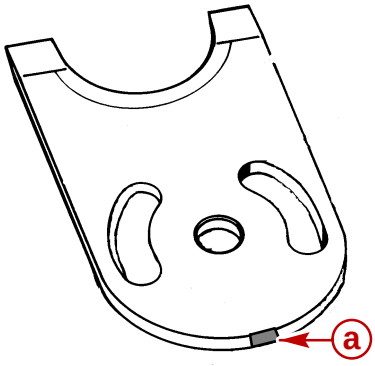
The shift cams on the latest style shift assembly can be identified by the part number being stamped in the cam.



75221

a - Shift Cam Part Number

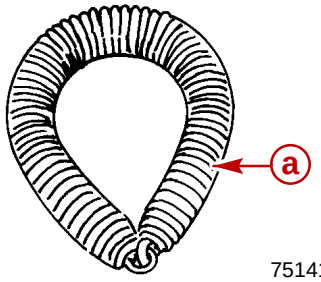
The yoke that is provided can be identified by a small patch of Yellow paint on the edge of the yoke.



75222

a - Paint Mark on Edge of Yoke

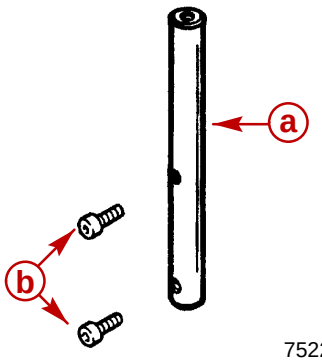
The garter springs in this kit have been identified with Orange paint on the inside diameter of the spring.



75141

a - Garter Spring

The shifter shaft and shorter screws in this kit must also be used when replacing the shifter components.



75224

a - Shifter Shaft
b - Screws

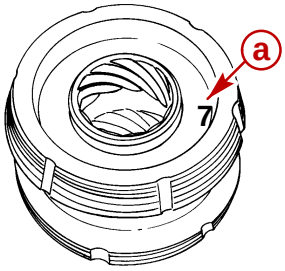
Index

Cone Clutch and Cam Kit (52-807375A1)

For Use on Bravo Sterndrive Units From Serial Number 0D764580 through 0F886005

IMPORTANT: The replacement parts in this kit must be used together. DO NOT mix any of your older style existing parts with parts from this kit. Also, if drive unit has previously been serviced with these latest style parts, individual parts can then be ordered for replacement.

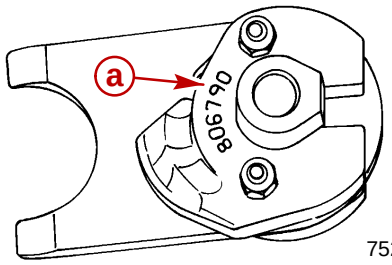
The latest style cone clutch in this kit is identified by the number “7” stamped in one end of the clutch as shown.



75140

a - Identification Number “7”

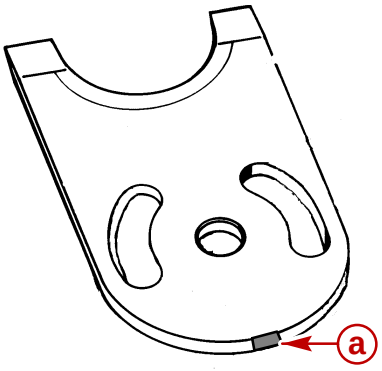
The shift cams on the latest style shift assembly can be identified by the part number being stamped in the cam as shown.



75221

a - Shift Cam Part Number

The yoke that is provided can be identified by a small patch of Yellow paint on the edge of the yoke.

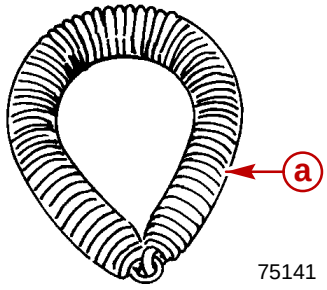


75222

a - Paint Mark on Edge of Yoke

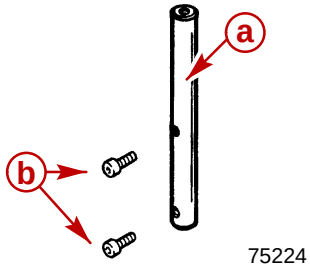
Index

The garter springs in this kit have been identified with Orange paint on the inside diameter of the spring.



a - Garter Spring

The shifter shaft and shorter screws in this kit must also be used when replacing the shifter components.



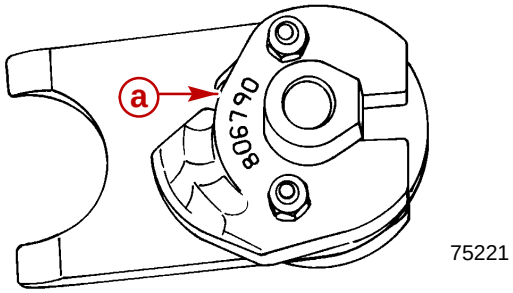
a - Shifter Shaft
b - Screws

Yoke and Cam Kit 806552A1

For Use on Bravo Sterndrive Units With Serial Number Above 0K091000

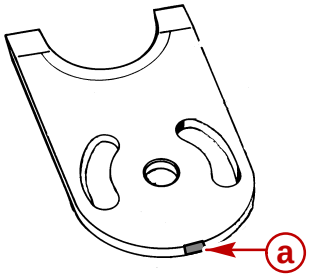
IMPORTANT: The replacement parts in this kit must be used together. DO NOT mix any of your older style existing parts with parts from this kit. Also, if drive unit has previously been serviced with these latest style parts, individual parts can then be ordered for replacement.

The shift cams on the latest style shift assembly can be identified by the part number being stamped in the cam as shown.



a - Shift Cam Part Number

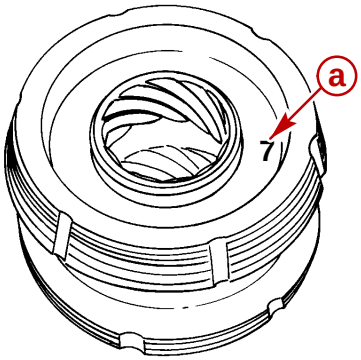
The yoke that is part of this latest style assembly can be identified by a small patch of Yellow paint on the edge of the yoke.



75222

a - Pint Mark on Edge of Yoke

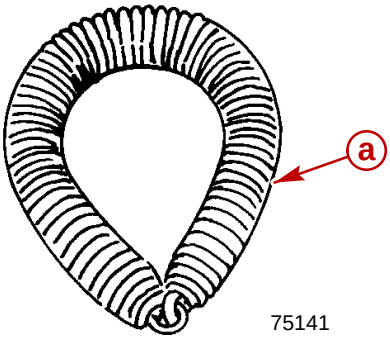
The yoke and cam assembly in this kit must be used with the latest style cone clutch which is identified by the number “7” stamped in one end of the clutch as shown.



75140

a - Identification Number “7”

The latest style garter springs must be used with the latest style clutch and can be identified by Orange paint on the inside diameter of the spring.

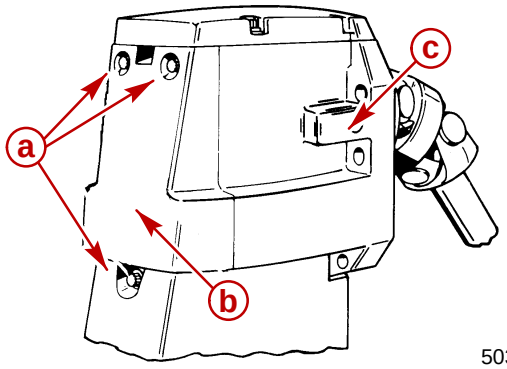


75141

a - Garter Spring

Drive Shaft Housing Disassembly

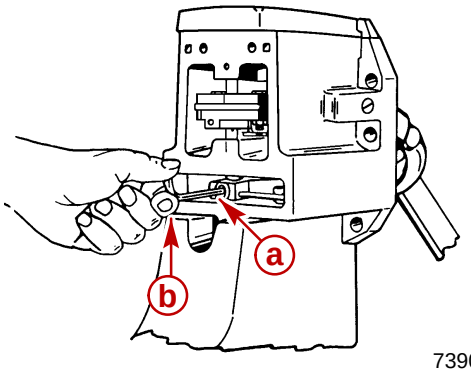
1. Shift drive unit to the neutral detent position.
2. Remove rear cover by removing screws. Do not replace vent screw until reassembly.



50303

a - Screws
b - Rear Cover
c - Vent Hole

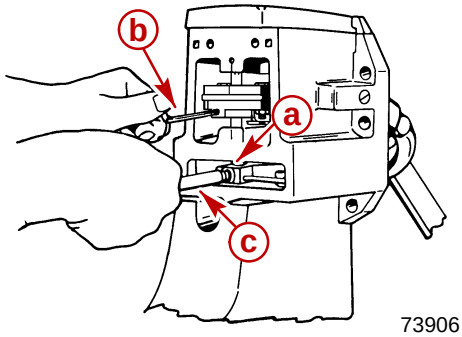
3. Remove shift linkage cap screw.



73905

a - Shift Linkage Cap Screw
b - Hex Wrench

4. Install shift handle tool (P/N 91-17302) into shift lever and shifter shaft to aid in removing shift cam cap screw.

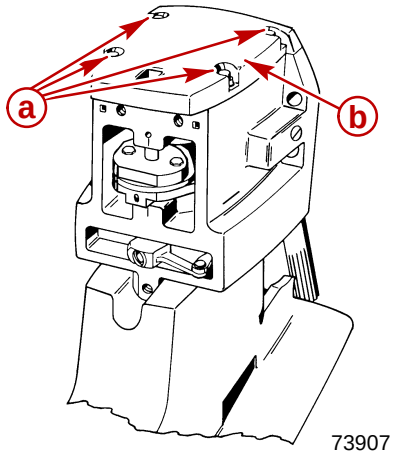


73906

a - Shift Cam Cap Screw
b - Hex Wrench
c - Shift Handle Tool

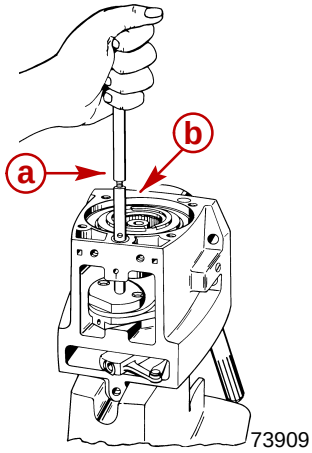
Index

5. Remove bolts and lift top cover.



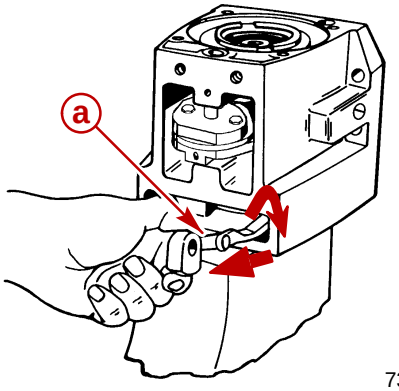
a - Bolts (4)
b - Cover

6. Install shift handle tool (P/N 91-17302) in shifter shaft and lift shaft straight out.



a - Shift Handle Tool
b - Shifter Shaft

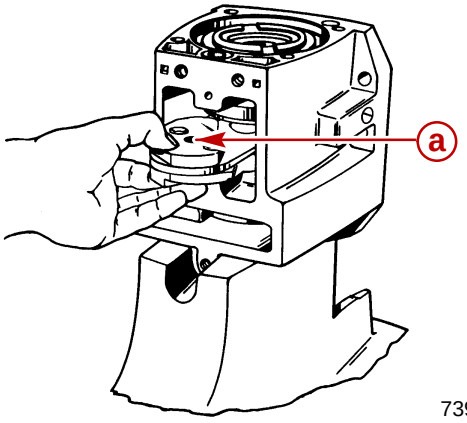
7. Remove shift linkage assembly.
   a. Rotate link bar 1/4 turn clockwise.
   b. Pull linkage assembly out. If linkage binds; move assembly from side to side while pulling.



a - Shift Linkage

Index

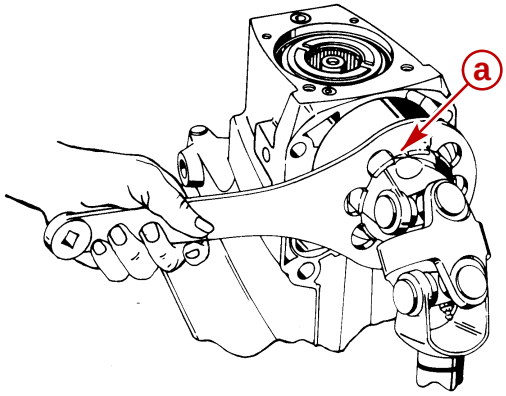
8. Remove yoke and cam assembly.



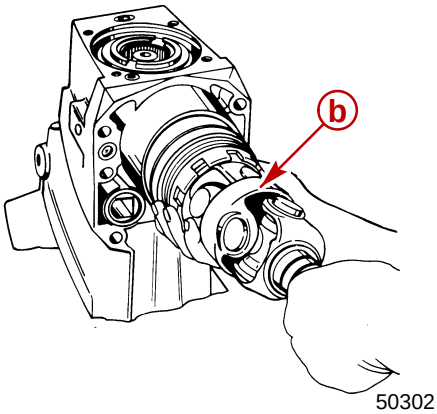
73910

a - Yoke and Cam Assembly

9. Loosen ring nut and remove pinion and U-joint assembly using U-joint retainer wrench (P/N 91-17256).



50303

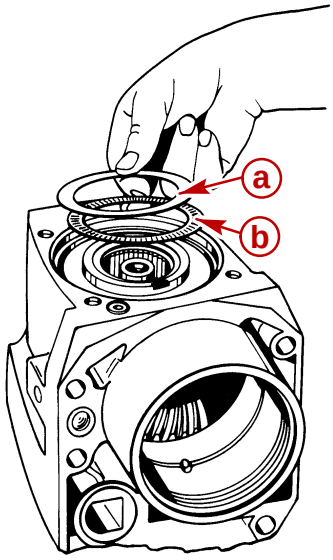


50302

a - Ring Nut
b - U-joint

IMPORTANT: In steps 10 and 12, be sure to note proper order and position of thrust races, thrust bearings and clutch assembly for later reassembly.

10. Remove upper thrust race (shim) and thrust bearing.



50304

a - Upper Thrust Race
b - Thrust Bearing

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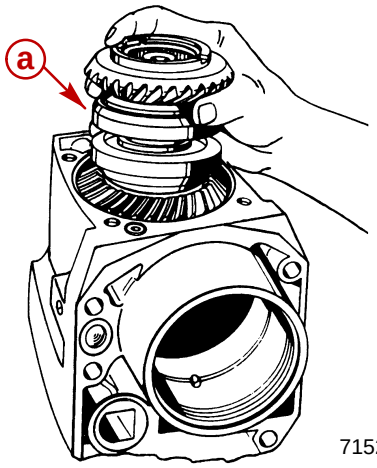
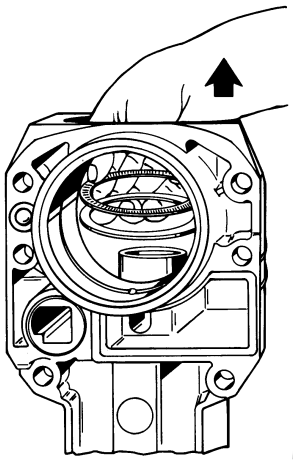
11. Remove clutch and gear assembly.



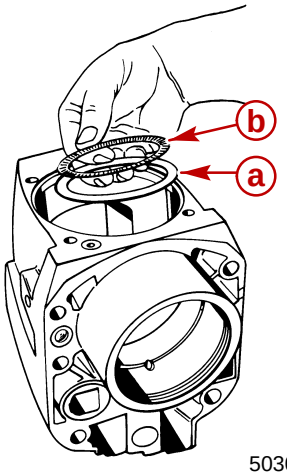
71520

a - Clutch and Gear Assembly

12. Remove lower thrust race (shim) and thrust bearing.



50341

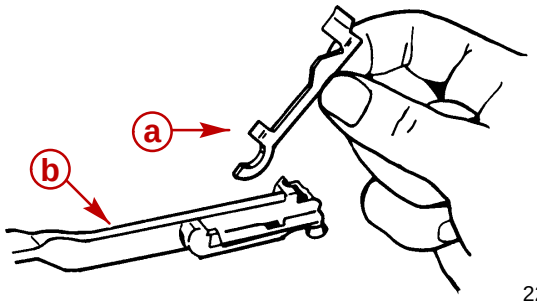


50304

a - Lower Thrust Race
b - Thrust Bearing

Shifter Repair

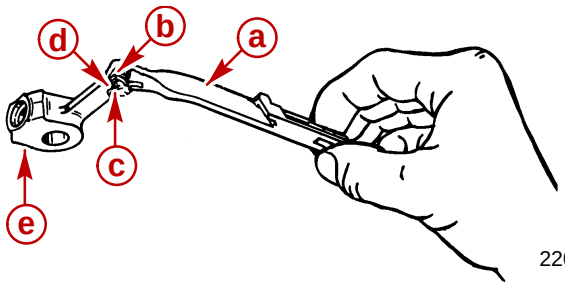
1. Remove latch from link bar.



22100

a - Latch
b - Link Bar

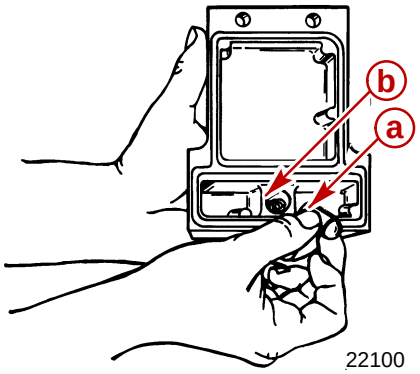
2. Remove link bar from shift lever. Discard cotter pin.



22099

a - Link Bar
b - Cotter Pin
c - Clevis Pin
d - Washer
e - Shift Lever

3. Remove ball detent canister and compression spring.

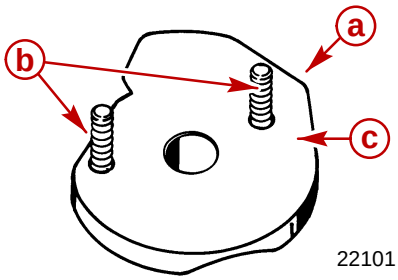


22100

a - Ball Detent Canister
b - Compression Spring

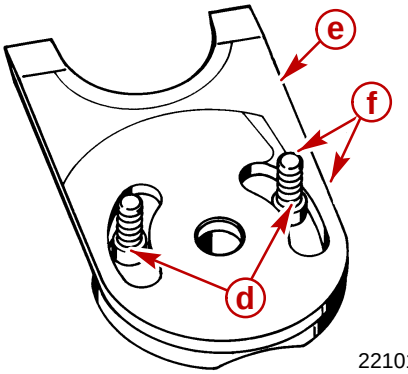
IMPORTANT: Refer to “Special Information” on page 24 if yoke and cam assembly components are being replaced.

4. Disassemble yoke and cam assembly. Coat contact surfaces with gear lube.

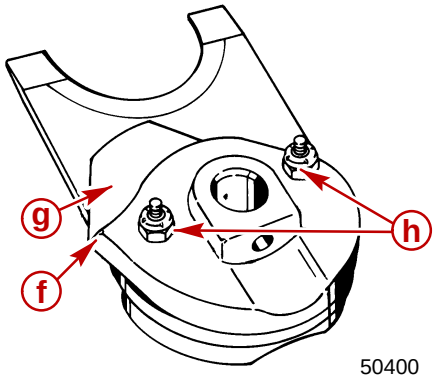


22101

a - Shift Cam
b - Bolts
c - Contact Surface



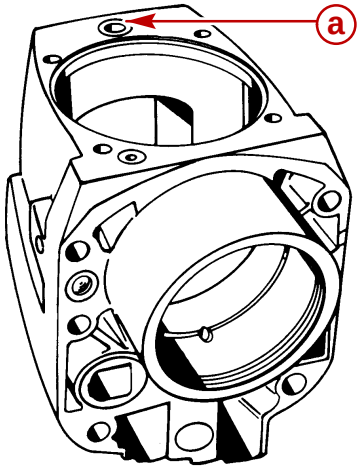
22101



50400

d - Spacers
e - Yoke
f - Contact Surface
g - Shift Cam
h - Locknuts

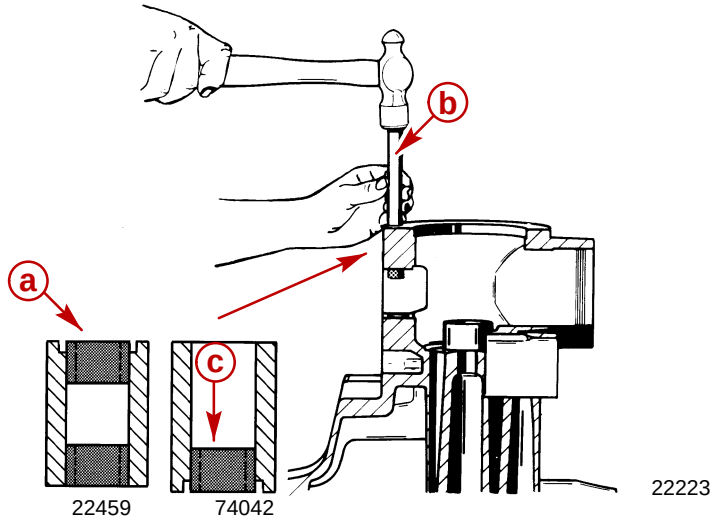
5. Remove shifter shaft upper O-ring.



50306

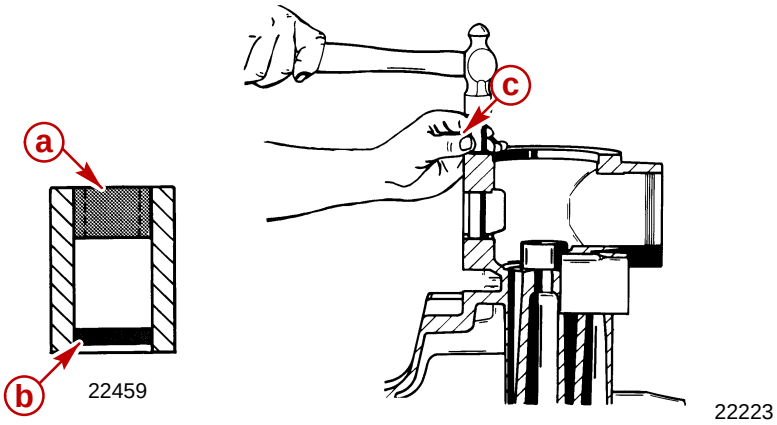
a - O-ring

6. Remove shifter shaft upper bushings using tool (P/N 91-17273).



a - Earlier Model Bushing
b - Shift Shaft Tool
c - Later Model Bushing

7. Remove shifter shaft lower bushing and oil seal using tool (P/N 91-17273).



a - Shift Shaft Lower Bushing
b - Oil Seal
c - Shift Shaft Tool

Shifter Inspection

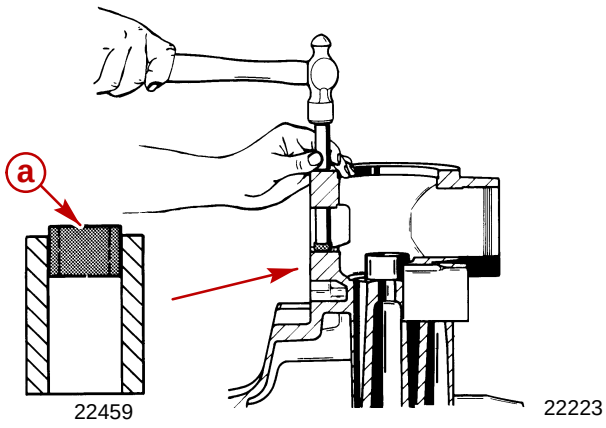
NOTE: *Use exploded parts views as reference.*

1. Shift link bar and shift lever for:
   - Damaged or bent parts
   - Worn jaw area
   - Excessively worn detent area on shift lever
2. Ball detent canister for:
   - Broken springs
   - Ball out of canister

3. Yoke and cam assembly for:
   - Damaged cam spacers
   - Excessively worn cam surface
4. Shifter shaft for:
   - Excessive wear in area where bushings make contact (Bushings must be replaced if replacing shifter shaft).
5. Shifter shaft bushing for:
   - Excessive wear
   - Knicks and scratches (shifter shaft must be replaced if replacing bushings)
6. Shifter shaft upper O-ring for:
   - Cuts and knicks
   - Flat spots (from being compressed)
7. Shift shaft lower oil seal for:
   - Cuts or knicks

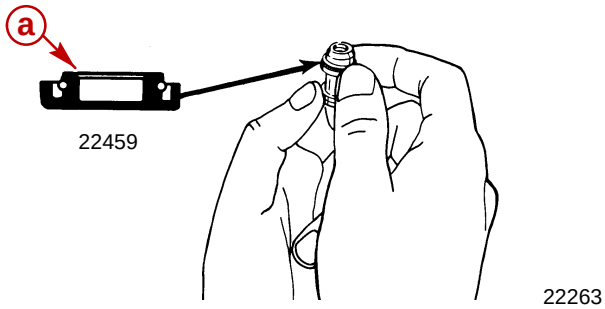
Shifter Reassembly

1. Install shifter shaft lower bushing and oil seal as follows:
   a. Install lower bushing part way into bore as shown.



a - Lower Bushing

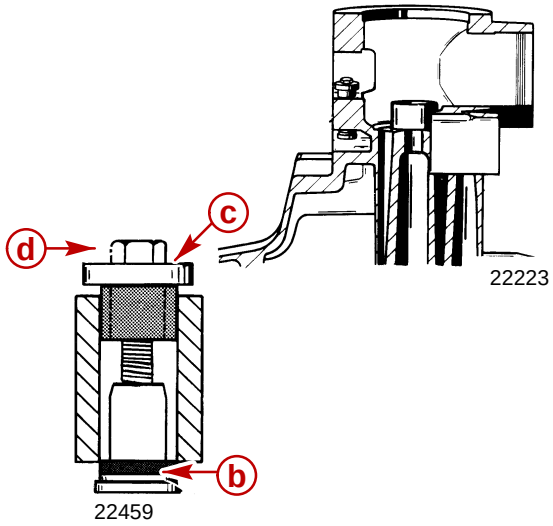
   b. Place oil seal onto bearing and seal driver (P/N 91-17275) with lip of seal facing upward. Apply Loctite 27131 to O.D. of seal before installation.



a - Oil Seal

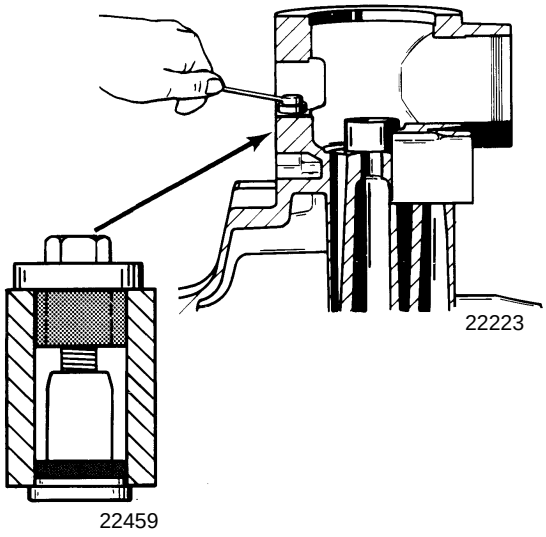
Index

c. Place bearing and seal drive with oil seal into bore from bottom. Place screw pilot (P/N 91-17274) through bushing from top. Install screw (P/N 10-20784) through screw pilot and into bearing and seal driver.



b - Seal Driver
c - Screw Pilot
d - Screw

d. Pull oil seal and bushing into place by turning screw clockwise until tool bottoms out on casting. (Top and Bottom).

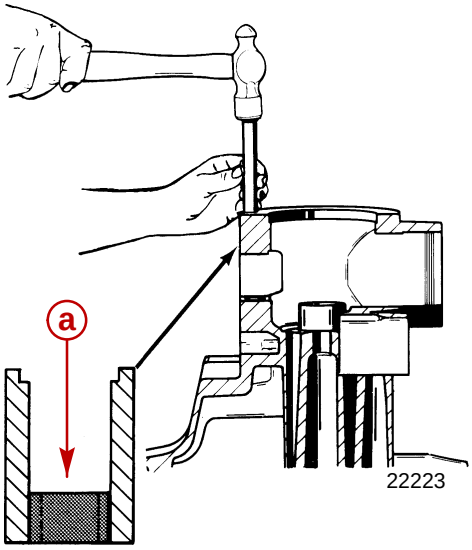


e. Loosen screw and remove tool.

2. Install shift shaft upper bushings as follows:

   a. Install bushing into bore so that bushing is flush with bottom of bore, as shown.

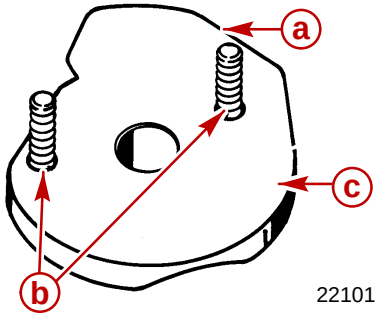
NOTE: *On older models, two bushings are no longer required.*



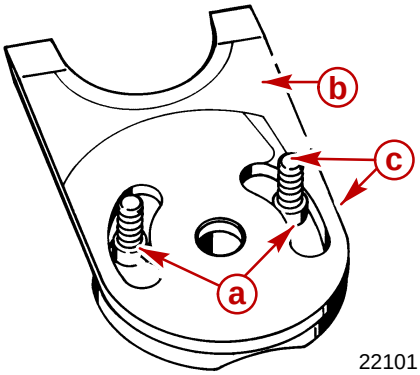
a - Bushing

IMPORTANT: Refer to “Special Information” on page 19 if yoke and cam assembly components are being replaced.

3. Assemble yoke and shift cam assembly. Coat contact surfaces with gear lube.
4. Torque locknuts to 80 lb. in. (8-9 N·m).



a - Shift Cam
b - Bolts
c - Contact Surface



a - Spacers
b - Yoke
c - Contact Surface

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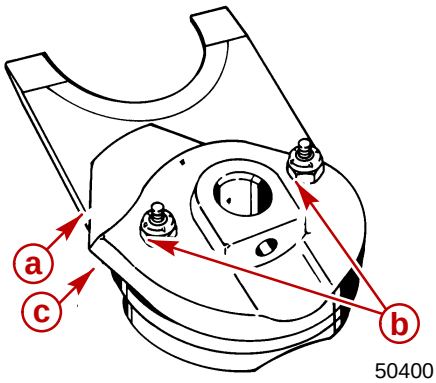
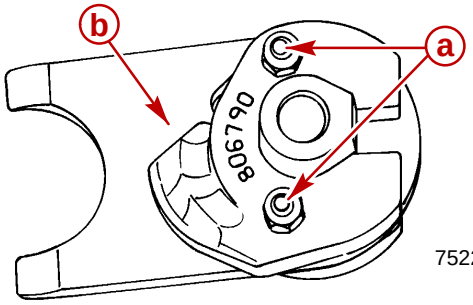


50400

Earlier Style Shifter Assembly

a - Shift Cam
b - Locknuts
c - Contact Surface

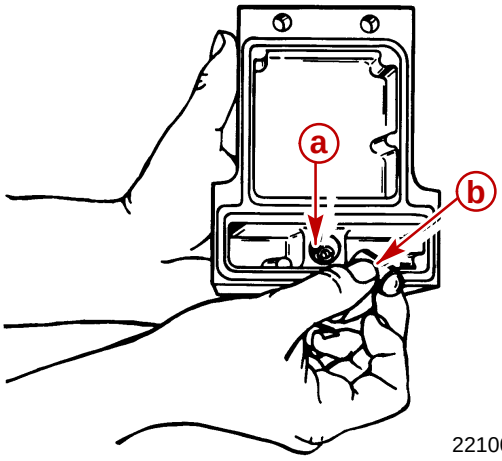


75221

Later Style Shifter Assembly

a - Locknuts
b - Shift Cam

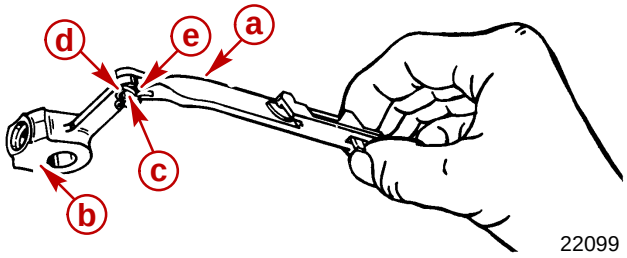
5. Lubricate parts with Special Lubricant 101 and install compression spring and ball detent canister into rear cover.



22100

a - Compression Spring
b - Detent Canister

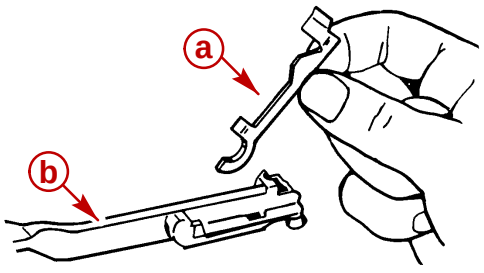
6. Install link bar to shift lever. Install cotter pin and spread ends.



22099

a - Link Bar
b - Shift Lever
c - Clevis Pin
d - Washer
e - Cotter Pin

7. Install latch on link bar.



22100

a - Latch
b - Link Bar

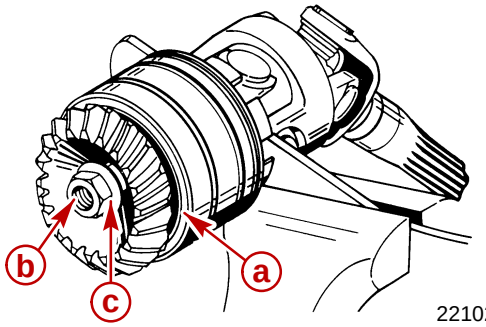
U-Joint and Pinion Gear Inspection, Disassembly and Reassembly

Inspection

1. Inspect pinion gear for pitting, chipped or broken teeth and excessive or uneven wear. If any of these conditions exist, it will be necessary to replace complete drive gear and bearing assembly.
2. Rotate bearings on pinion gear by hand. Rough, uneven movement, or a loose condition indicates need for replacement. If drive gear is in good condition then it will be necessary to replace bearings only.
3. Inspect U-joints for a loose or rough movement and deteriorated seals. If any of these conditions exist, then replace cross and bearing assembly.

Disassembly

1. Remove nut and washer from U-joint shaft and remove drive gear and bearings as an assembly. Remove remaining components.



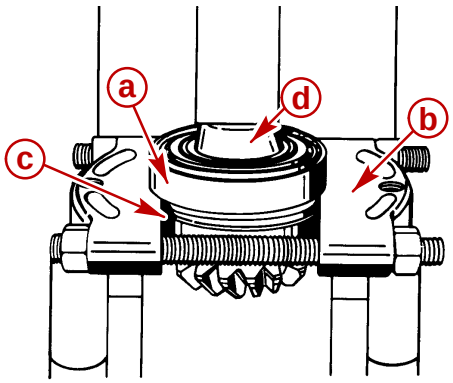
22102

a - Drive Gear and Bearing Assembly
b - Nut
c - Washer

⚠ CAUTION

DO NOT damage spacer when removing first bearing from pinion gear, spacer must be used in reassembly.

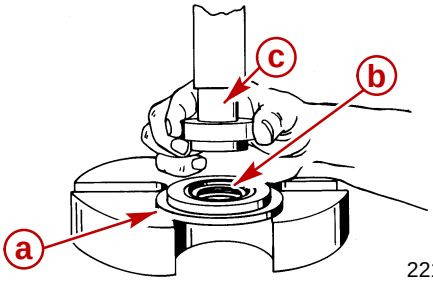
2. If you determine, by inspection, that U-joint bearings are in need of replacement and that gear is still in good condition, then remove bearings from gear, using puller plate (91-37241) and arbor press (bearings are damaged in removal and should not be re-used).



22393

a - Gear and Bearing Assembly
b - Puller Plate
c - Spacer (Save for Reassembly)
d - Suitable Mandrel

3. If seal is defective, remove U-joint seal from carrier using a punch and hammer or press out with suitable mandrel.



22102

a - Seal Carrier
b - Seal – Remove and Discard
c - Suitable Mandrel

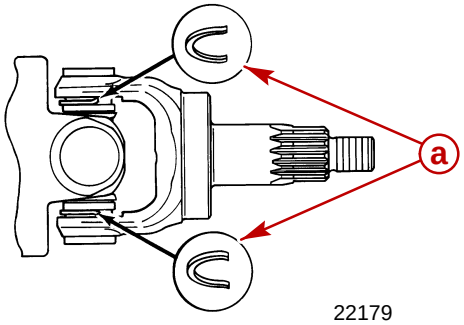
Index

4. If inspection determines that U-joint cross bearings should be replaced, proceed as follows.

⚠ WARNING

U-joint snap rings might accidentally be knocked off of the u-joint during installation. Wear safety glasses to avoid eye injury.

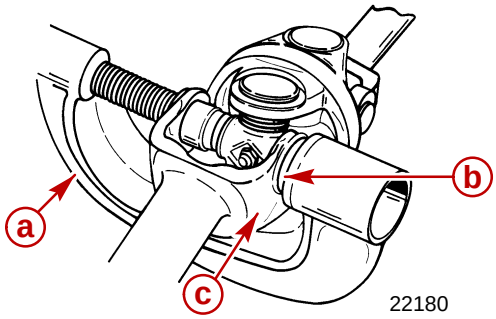
a. Drive off universal joint bearing snap rings, using a punch and hammer.



22179

a - Snap Ring

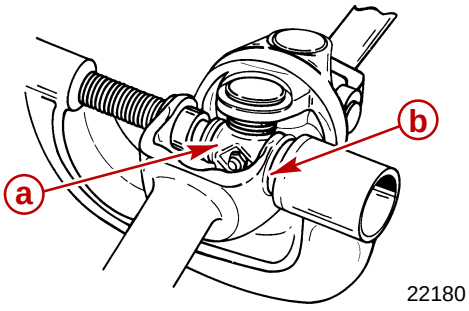
b. Using adaptor (P/N 91-38756) and U-joint press, press one bearing in until opposite bearing is pressed out into adaptor. Remove loose bearing.



22180

a - Press
b - Adaptor
c - Yoke

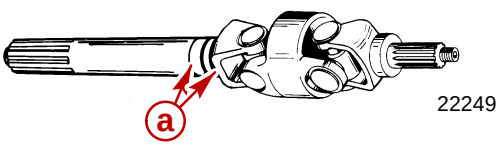
c. Turn U-joint assembly 180 degrees and press on bearing cross to remove second bearing. Remove second bearing. Remove each pair of bearings in this manner.



22180

a - Bearing Cross
b - Adaptor

5. Remove both O-rings from coupling end of U-joint shaft.



22249

a - O-rings

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Reassembly

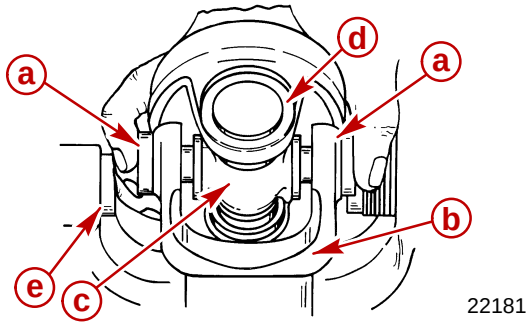
⚠ CAUTION

Use only Quicksilver U-Joint and Gimbal Bearing Grease for lubricating U-joint bearings. The use of any other lubricant will decrease the life of the bearings.

1. Reassemble U-joints as follows:

NOTE: *When initially positioning crosses in yoke, be sure that grease fittings are facing to coupler yoke (longer yoke).*

a. Place U-joint bearing cups in yoke and start them on bearing cross members. Install by using adaptor (91-38756) and pressing bearing through yoke and onto cross members.

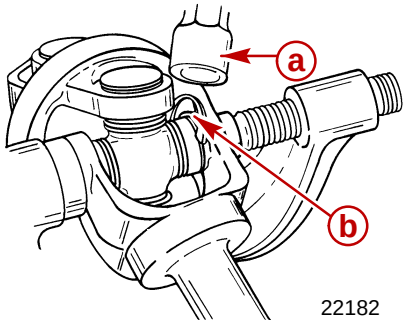


a - Bearings
b - Yoke
c - Cross Members
d - Grease Fitting (Facing Longer Yoke)
e - Adaptor

⚠ WARNING

U-joint snap rings might accidentally be knocked off of the u-joint during installation. Wear safety glasses to avoid eye injury.

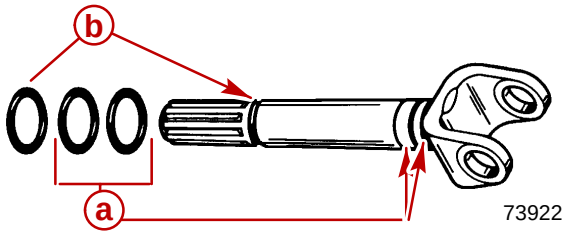
b. Install bearing cup retaining snap rings.



a - Hammer
b - Snap Ring

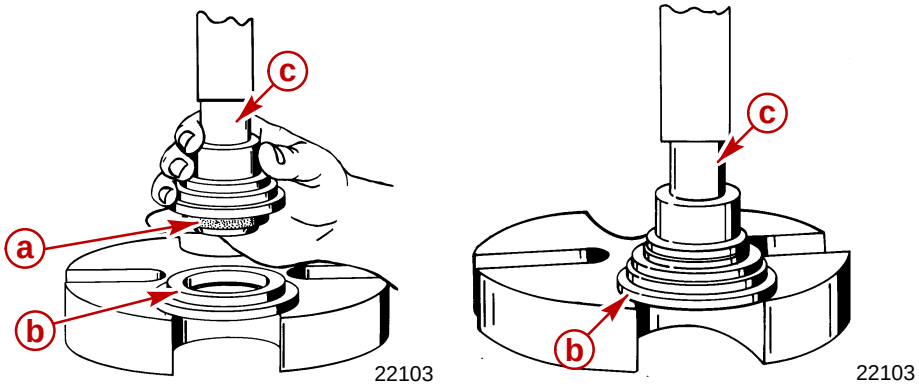
c. Install each pair of bearings in this manner.

2. Install two new O-rings in grooves on coupling end of U-joint shaft. Later Models also have an O-ring on the spline end of the shaft.



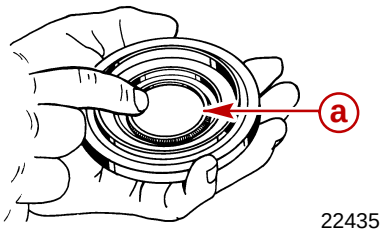
a - O-rings
b - Additional O-ring (Later Models Only)

3. Coat O.D. of oil seal with Loctite 27131 and press oil seal into oil seal carrier with lip of seal facing concave side of carrier, using bearing driver (P/N 91-89868) until tool bottoms out against carrier.



a - Oil Seal
b - Oil Seal Carrier
c - Bearing Driver

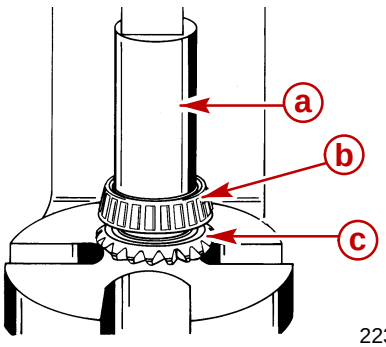
4. Lubricate lip of oil seal (a) with 2-4-C Marine Lubricant with Teflon.



a - Oil Seal Lip

5. If tapered roller bearings were removed from pinion gear, replace as follows.

   a. Press smaller O.D. bearing onto pinion gear using tool 91-90774.



a - Tool 91-90774
b - Bearing - Smaller O.D.
c - Pinion Gear

Index

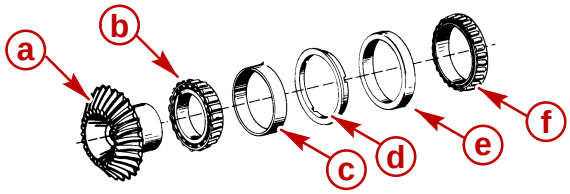
⚠ CAUTION

If spacer is not installed correctly in next step, severe damage to the drive unit will result during reassembly.

b. Place smaller O.D. cup over bearing pressed on in step “a”.

c. Install spacer (flat face toward gear).

d. Install larger O.D. bearing cup.



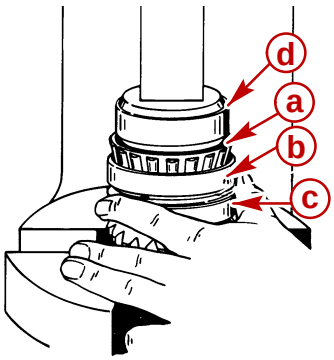
22249

a - Pinion Gear
b - Smaller O.D. Bearing (First)
c - Smaller O.D. Cup (Second)
d - Spacer – Wider Face Toward Gear (Third)
e - Larger O.D. Bearing Cup (Fourth)
f - Larger O.D. Bearing (Fifth)

⚠ CAUTION

Spacer between bearing cups must be free to move. Do not over press, as damage to both bearings could occur.

e. Press larger O.D. bearing onto gear. Press bearing to the point where bearing rollers initially make contact with tapered bearing cup.



22393

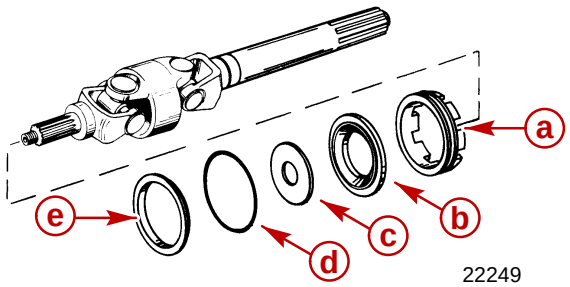
a - Bearing – Larger O.D.
b - Larger O.D. Bearing Cup
c - Spacer – Must Move Freely
d - Suitable Mandrel – Must Push on Inner Bearing Race

NOTE: *If a slight over press condition occurs (spacer does not move freely) – support large O.D. bearing cup with universal puller plate and lightly tap end of pinion gear with a soft hammer. Failure to do this can result in premature bearing failure.*

⚠ CAUTION

U-joint and pinion gear assembly must be reassembled as shown in following steps or damage to drive unit will occur during reassembly.

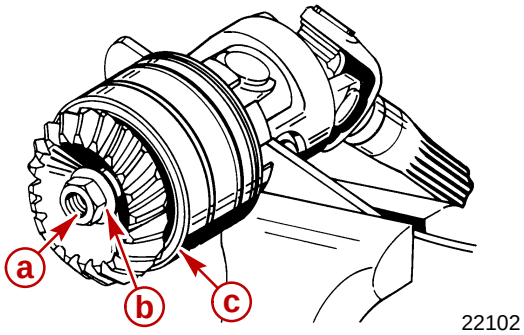
6. Install components as shown.



22249

a - Retainer Nut (Threaded End Toward Pinion Gear)
b - Oil Seal Carrier (Lip of Seal Facing Pinion Gear)
c - Large Washer (Taper Facing U-joints)
d - O-ring (Position Between Oil Seal Carrier and Sealing Ring)
e - Sealing Ring (Taper Facing U-joints)

7. Secure pinion gear assembly to shaft with washer and new nut. Tighten nut to the point where washer just touches gear.

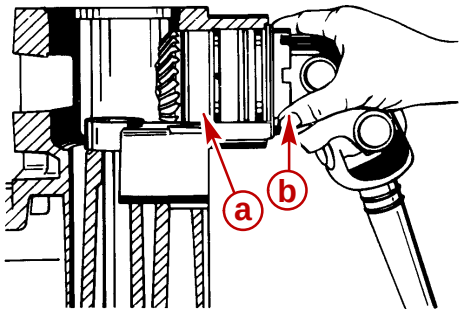


22102

a - Nut
b - Washer
c - Pinion Gear Assembly

8. Set the preload on bearing package as follows:

   a. Install U-joint and pinion gear assembly into drive shaft housing. Apply Special Lubricant 101 to retaining nut prior to installing. Tighten retaining nut hand tight.

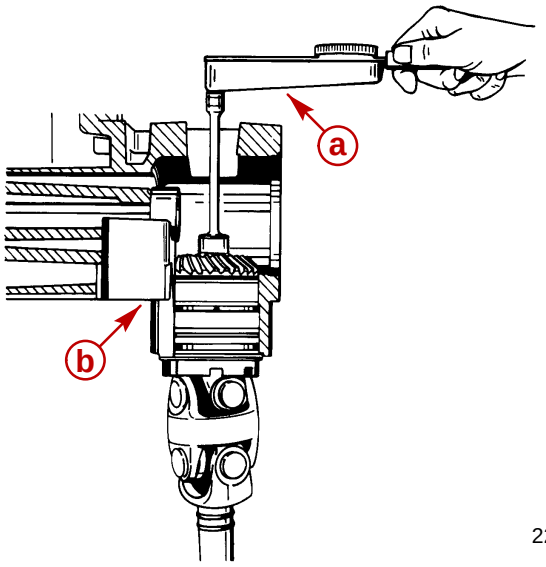


22220

a - U-joint and Pinion Gear Assembly
b - Retaining Nut

   b. Position drive shaft housing so that U-joint coupling shaft is pointing straight down.

c. Set preload by tightening nut 1/16 of a turn at a time. Check for proper preload by turning pinion gear, using an extension, appropriate socket, and torque wrench (lb. in. - with dial indicator), until a 6-10 lb. in. (0.7-1.1 N·m) torque is obtained. If nut becomes over-tightened (causing excessive preload), loosen nut a number of turns and lightly strike pinion end of U-joint shaft using a soft bar and hammer. Readjust, starting at beginning of this step.



22220

a - Torque Wrench (lb. in. – Dial Indicator)
b - Drive Shaft Housing (U-joint Shaft Hanging Straight Down)

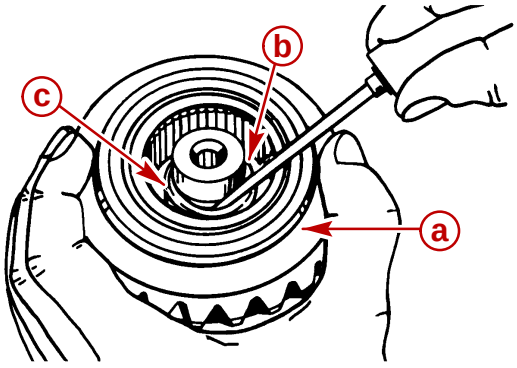
9. Remove U-joint and pinion gear assembly from drive shaft housing until clutch assembly is installed.

Clutch Disassembly, Inspection and Reassembly

IMPORTANT: Refer to “Special Information” on page 19 if gear assembly components are being replaced.

Disassembly

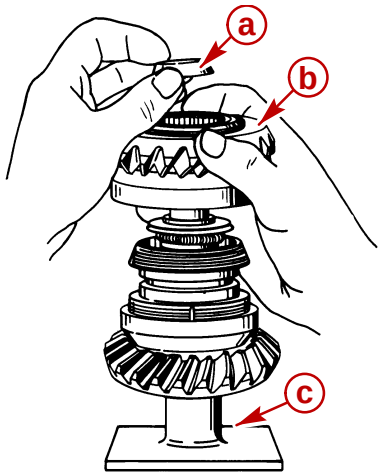
1. Remove top gear by pressing down on gear to release keepers and collar.



22105

a - Top Gear
b - Thrust Collar
c - Keepers (2)

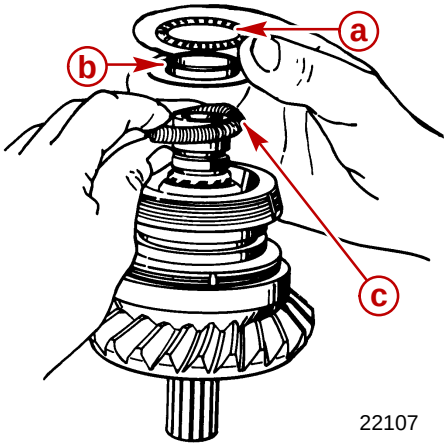
2. Remove thrust collar and gear from shaft.



22106

a - Thrust Collar
b - Top Gear
c - Stand (P/N 91-17301A1)

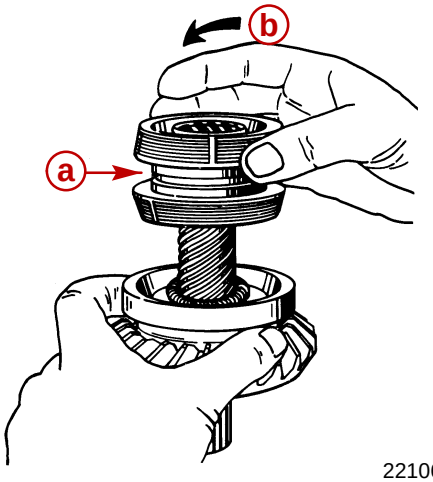
3. Remove thrust bearing, thrust race and garter spring.



22107

a - Thrust Bearing
b - Thrust Race
c - Garter Spring

4. Twist clutch counterclockwise while pulling up to separate clutch from shaft.

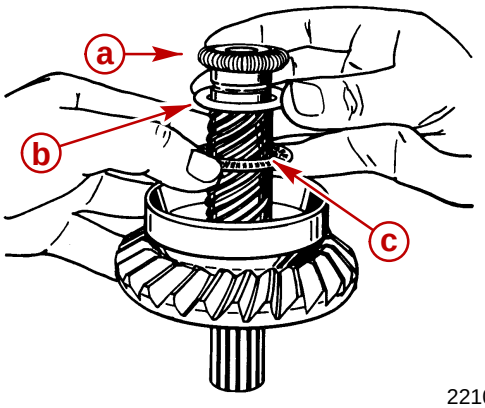


22106

a - Clutch
b - Twist in This Direction

Index

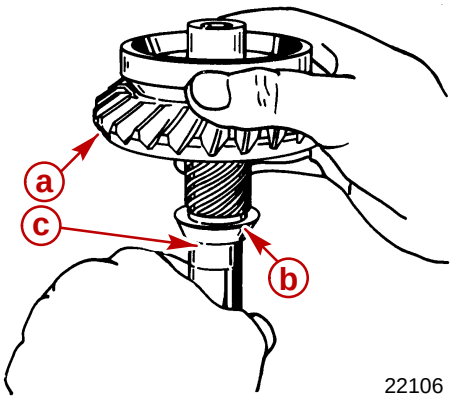
5. Remove lower garter spring, thrust race, and thrust bearing.



22105

a - Garter Spring
b - Thrust Race
c - Thrust Bearing

6. **Earlier Style with removable thrust collar:** remove bottom gear, pull thrust collar up and remove keepers.



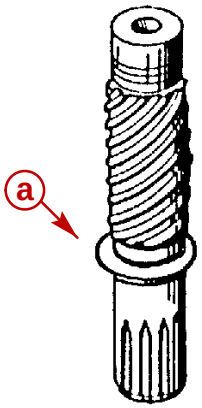
22106

Earlier Style Shaft

a - Bottom Gear
b - Thrust Collar
c - Keepers (2)

7. **Later Style Shaft:** remove bottom gear.

NOTE: *On Later Style shaft, thrust collar is cast as part of shaft and keepers are not used.*



72056

Later Style Shaft

a - Collar (Cast as Part of the Shaft)

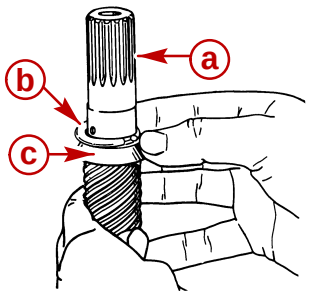
Index

Inspection

1. Clean all parts in nontoxic solvent; then dry with compressed air. Be careful not to spin bearings. Inspect gears for pitting, chipped or broken teeth, and excessive or uneven wear. Replace gear if any of these conditions exist.
2. Condition of bearing surfaces in drive shaft housing and top cover are an indication of the condition of the bearings in the gears. Inspect bearing surface for pitting, grooves, scoring, discoloration from overheating, uneven wear, and embedded foreign metal particles. Replace gear and bearing assembly, and also bearing sleeve, if any of these conditions exist.
3. Inspect socket of gear for particles adhering to clutch surface, and for discoloration. If particles and/or discoloration are present, attempt to clean up grooves on clutch using a bead blaster or a pick. (Do not use a wire brush or wire wheel.) If, after cleaning, grooves appear to be flattened or Nicked, clutch should then be replaced.
4. Inspect splines of clutch shaft for knicks or broken teeth. If any of these conditions exist, replace shaft.
5. Inspect bearing surfaces on clutch shaft for pitting, grooves, scoring, or discoloration. Replace shaft if any of these conditions exist.

Reassembly

1. **Earlier Style Shaft:** place thrust collar on splined end of shaft, lubricate keepers with 2-4-C Marine Lubricant with Teflon and position in groove. Pull thrust collar over keepers.



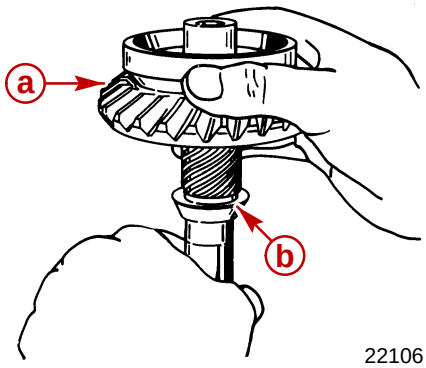
22106

Earlier Style Shaft

a - Clutch Shaft
b - Keepers (2)
c - Thrust Collar

NOTE: *On Later Style Shaft thrust collar is part of shaft and there are no keepers.*

2. **Both Styles:** Apply gear oil to splines and install bottom gear on shaft and allow it to rest on thrust collar.

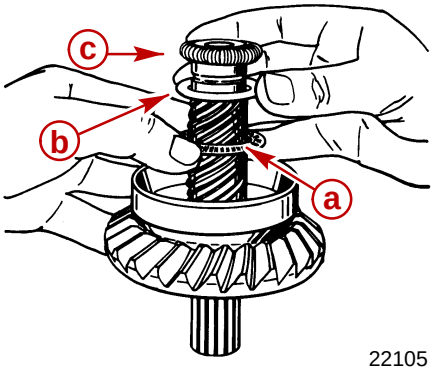


22106

a - Bottom Gear
b - Thrust Collar

Index

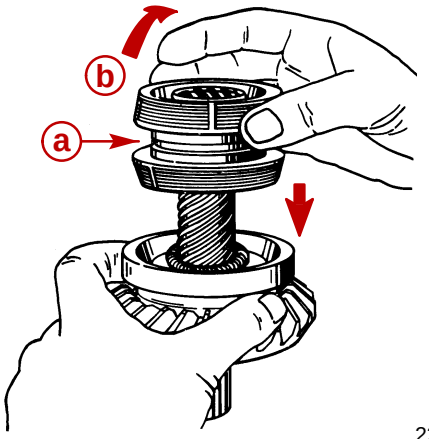
3. Install thrust bearing, thrust race, and garter spring, in that order. Lubricate parts with Gear Lube.



22105

a - Thrust Bearing
b - Thrust Race (Lip Facing Down)
c - Garter Spring

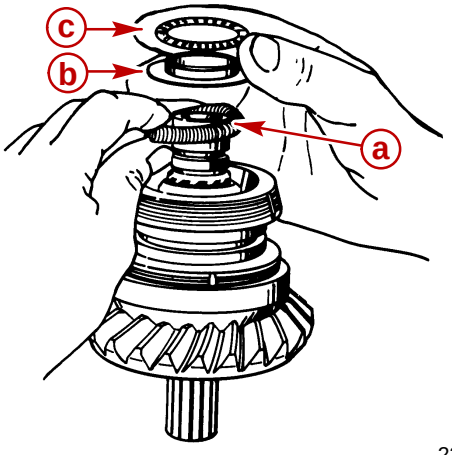
4. Lower clutch over shaft while allowing it to turn clockwise.



22106

a - Clutch
b - Turn Clutch in This Direction

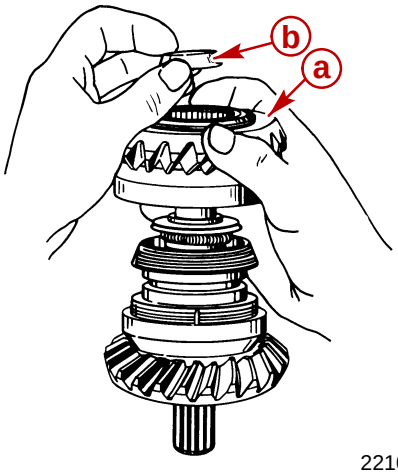
5. Install top garter spring, thrust race and thrust bearing, in that order.



22107

a - Garter Spring
b - Thrust Race (Lip Facing Up)
c - Thrust Bearing

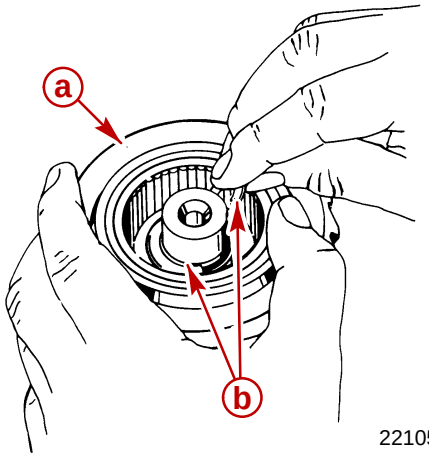
6. Place top gear and then thrust collar over shaft.



22106

a - Top Gear
b - Thrust Collar

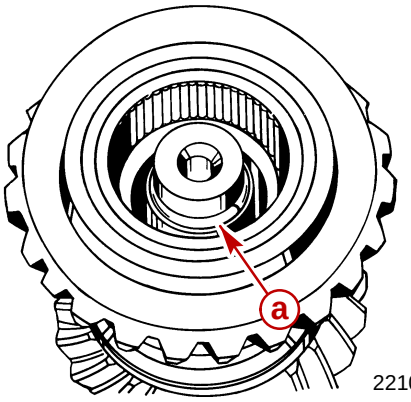
7. Press gear and thrust collar down so that groove in shaft is completely exposed. Install keepers.



22105

a - Top Gear
b - Keepers (2)

8. Release pressure from gear. Thrust collar should come up to the point where top of keepers are level with top of thrust collar at position shown.



22105

a - Keepers Level with Thrust Collar

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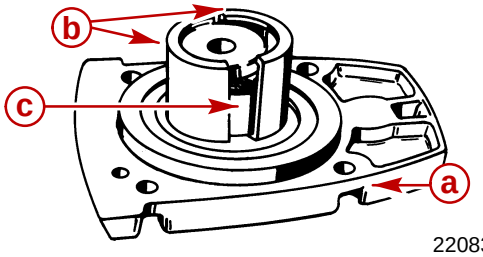
Drive Shaft Housing and Top Cover - Bearings and Bearing Sleeves

Inspection

1. Inspect needle bearing races in top cover and in drive shaft housing for pitting, grooves, discoloration or embedded particles. If any of these conditions exist, replace race.
2. Condition of the bearing surfaces on the clutch shaft are an indication of the condition of the bearings in the top cover and drive shaft housing. Inspect bearing surface for pitting, grooves, discoloration or embedded particles. If any of these conditions exist, then replace bearings and shaft.

Bearing Sleeve Removal (Top Cover)

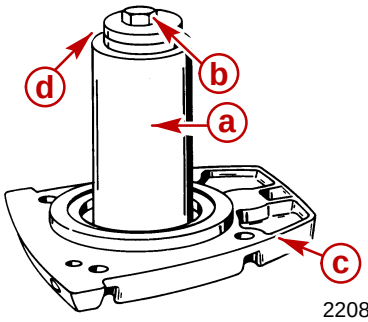
1. Place puller jaws around sleeve.



22083

a - Top Cover
b - Puller Jaws (2 Halves) – (P/N 91-90777A1 & 91-90778)
c - Sleeve

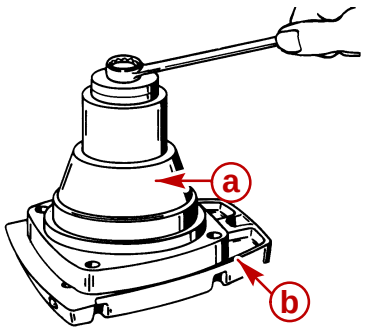
2. Position puller guide over jaws and install bolt.



22084

a - Puller Guide (P/N 91-90774)
b - Puller Bolt (P/N 90-90775)
c - Top Cover
d - Suitable Spacers

3. Install driver guide as shown.



22082

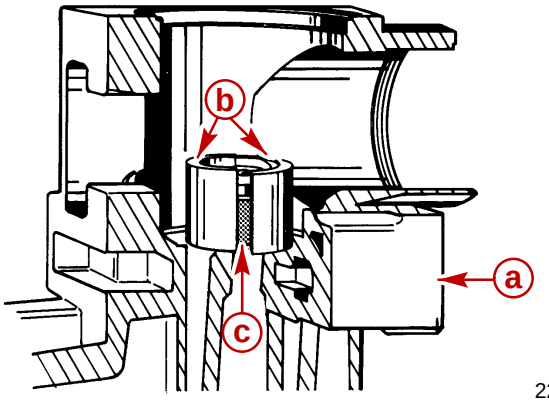
a - Driver Guide (P/N 92-90244)
b - Top Cover

4. Remove sleeve by rotating bolt clockwise.

Index

Bearing Sleeve Removal (Drive Shaft Housing)

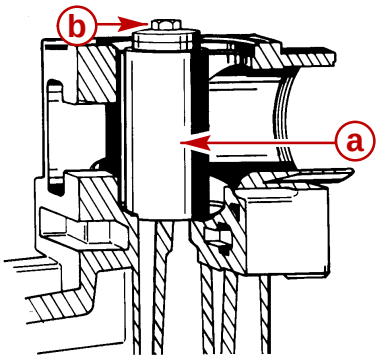
1. Place puller jaws around sleeve.



22219

a - Drive Shaft Housing
b - Pull Jaws (2 Halves) (P/N 91-90777A1 & 91-90778)
c - Sleeve

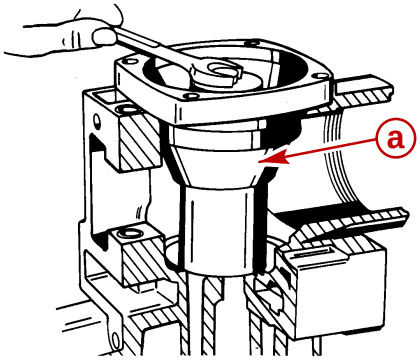
2. Position puller guide over jaws and install bolt.



22263

a - Puller Guide (P/N 91-90774)
b - Puller Bolt (P/N 10-90775)

3. Install driver guide as shown.



22258

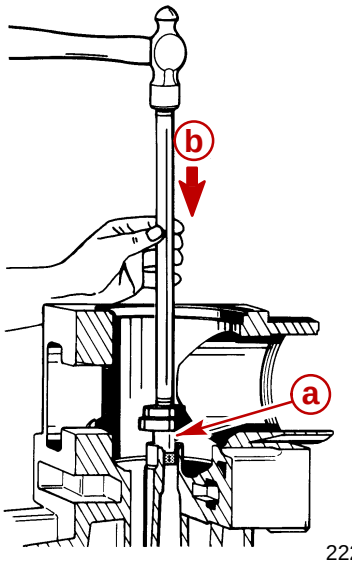
a - Driver Guide (P/N 91-90244)

4. Remove sleeve by rotating bolt clockwise.

Index

Roller Bearing Removal

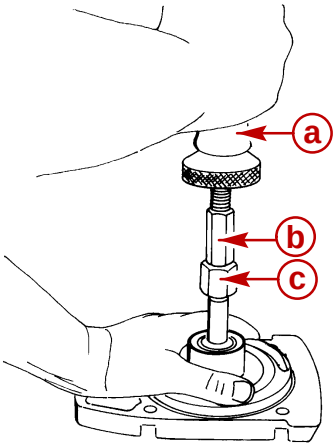
1. To remove roller bearing from drive shaft housing, use a suitable mandrel and drive bearing down into oil cavity.



22260

a - Bearing and Mandrel
b - Drive in this Direction

2. Use a slide hammer puller (91-34569A1) and Snap-On adaptor and puller head (Snap-On P/N CG-40-4, CG-40-A10) as shown.

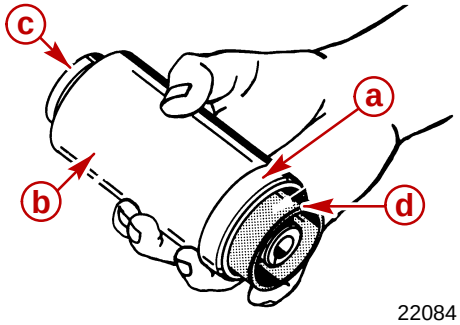


73928

a - Slide Hammer Puller (91-34569A1)
b - Adaptor (CG-40-4)
c - Puller Head (CG-40-A10)

Bearing Sleeve Installation

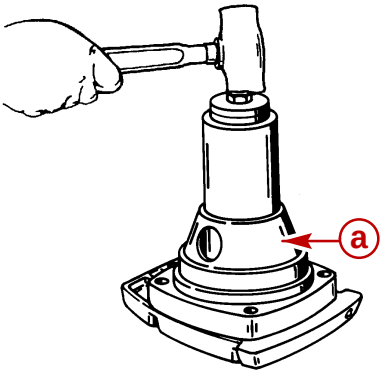
1. Install driver head (P/N 91-90773) onto puller guide (P/N 91-90774). Secure driver head to puller guide with screw (P/N 10-90775). Place bearing sleeve against edge of driver head as shown.



22084

a - Driver Head (91-90773)
b - Puller Guide (91-90774)
c - Screw (91-90775)
d - Bearing Sleeve

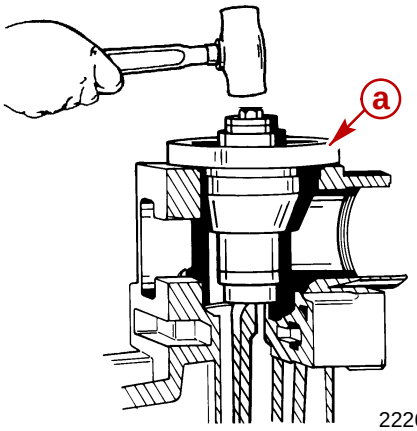
2. Place driver guide (P/N 91-90244) onto top cover as shown. Install puller guide assembly through driver guide assembly and install bearing sleeve by tapping into place until tool bottoms out.



22082

a - Driver Guide (91-90244)

3. Place driver guide (P/N 91-90244) into top of drive shaft housing, as shown. Install puller guide assembly through driver guide and install bearing sleeve by tapping into place until tool bottoms out.



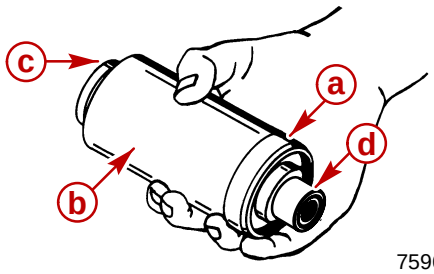
22263

a - Driver Guide (91-90244)

Index

Roller Bearing Installation

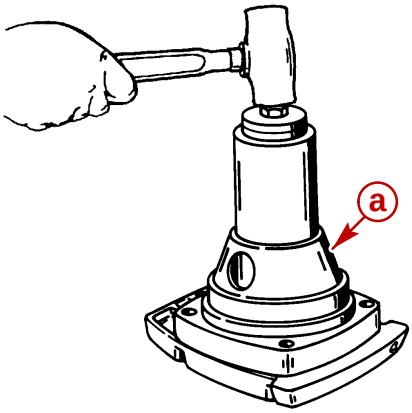
1. Install driver head (P/N 91-90773) onto puller guide (P/N 91-90774). Secure driver head to puller guide with screw (P/N 10-90775). Lubricate I.D. of roller bearing and place roller bearing on driver head, as shown.



75967

a - Driver Head (91-90773)
b - Puller Guide (91-90774)
c - Screw (91-90775)
d - Roller Bearing

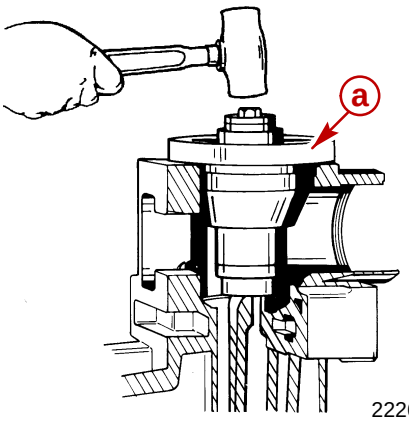
2. Place driver guide (P/N 91-90244) on top cover, as shown. Install puller guide assembly through driver guide and install roller bearing by tapping into place until tool bottoms out.



75968

a - Driver Guide (91-90244)

3. Place driver guide (P/N 91-90244) into top of drive shaft housing, as shown. Install puller guide assembly through driver guide and install roller bearing by tapping into place until tool bottoms out.

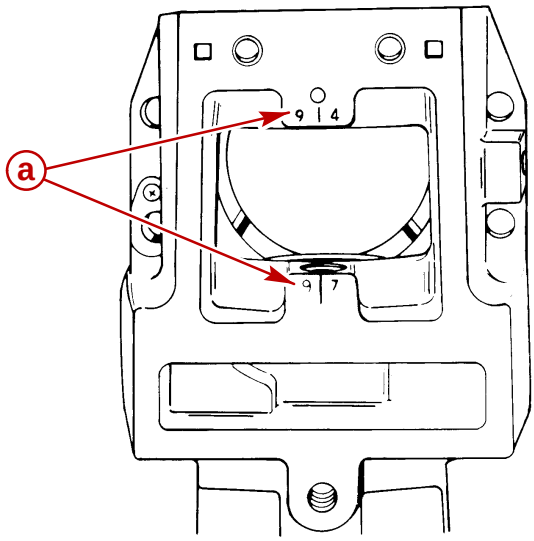


22263

a - Driver Guide (91-90244)

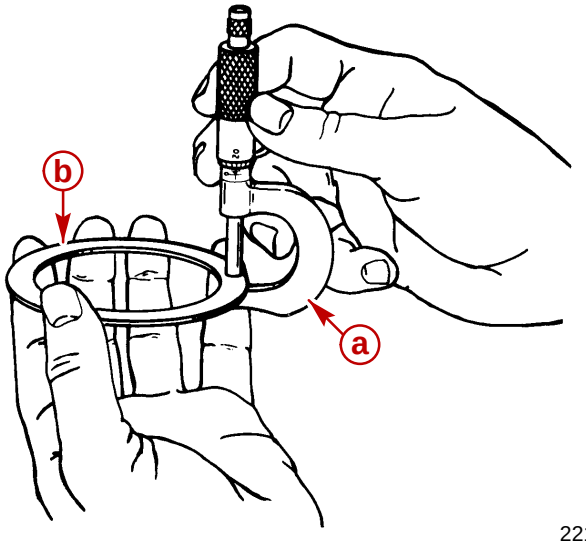
Drive Shaft Housing Reassembly

IMPORTANT: Two (2) numbers are stamped in the shifter cavity on the back of the drive shaft housing. The top number designates the thickness of the top thrust bearing race, and the bottom number designates the thickness of the bottom thrust bearing race. One of three numbers appears in each position (91, 94, 97) e.g. 91 = .091 in. Use numbers that are stamped in housing as a guide for obtaining replacement parts. Measure thrust bearing races with a micrometer to be sure that their thickness correspond to the numbers stamped in the drive shaft housing.



50303

a - Stamped Number



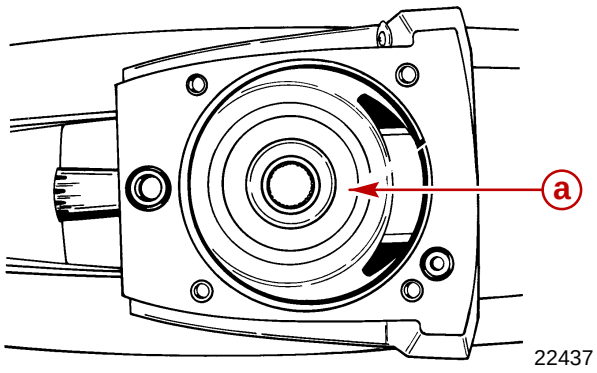
22100

a - Micrometer
b - Race

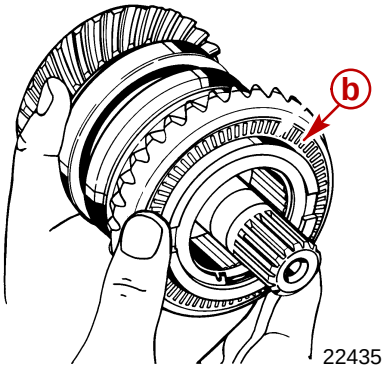
NOTE: *If using original thrust bearing race, race should be installed so that the side of original contact area is in the same position as removed. Prelube all races and bearings with High-Performance Lube.*

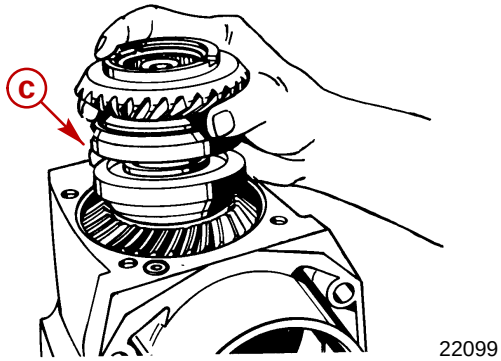
Index

1. Position correct thrust bearing race in drive shaft housing (see “Important,” preceding); then apply a mixture of 60% Hi Performance Gear Lube and 40% Special Lubricant 101 to bottom face of clutch assembly bottom gear and thrust bearing. Stick thrust bearing to gear. Install clutch assembly.



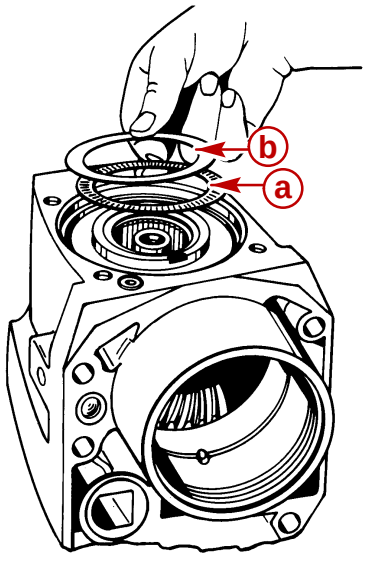
a - Thrust Bearing Race





b - Thrust Bearing
c - Clutch Assembly

2. Apply a mixture of 60% Hi Performance Gear Lube and 40% Special Lubricant 101 to the top face of clutch assembly top gear and the thrust bearing. Place thrust bearing on gear. Position correct thrust bearing race on top of thrust bearing.

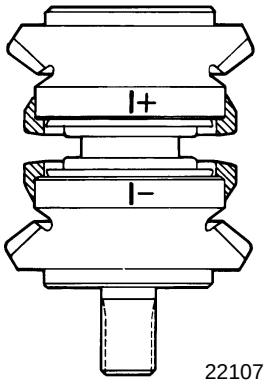


a - Thrust Bearing
b - Thrust Race

⚠ CAUTION

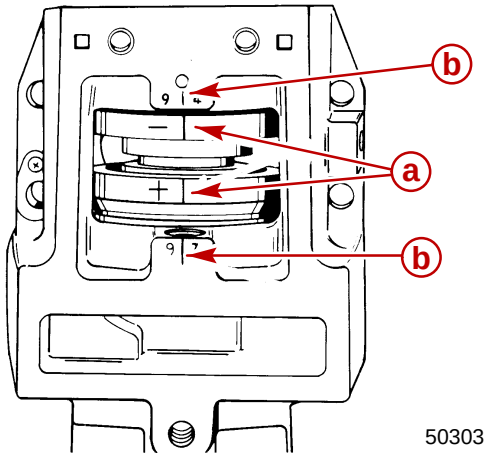
Clutch gears must be timed as shown, following, or damage to clutch gears and U-joint pinion gear may occur.

IMPORTANT: Timing marks on clutch gears must be aligned in one of two ways. The positive (+) mark over the negative (–) or the negative (–) mark over the positive (+) mark. NEVER align two positive (+) marks or two negative (–) marks.



22107

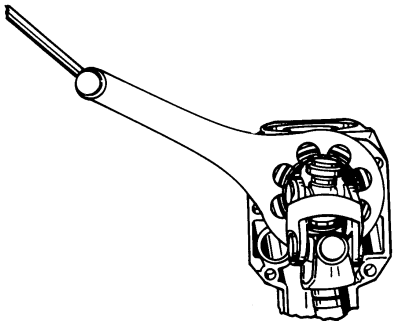
3. Align clutch gear timing marks with index marks on drive shaft housing as close as possible.



50303

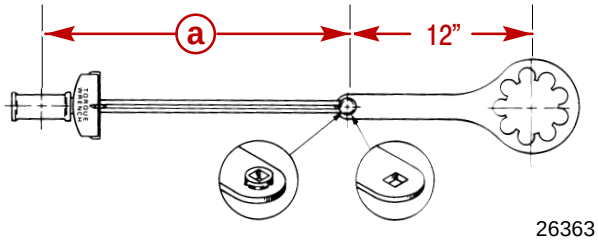
a - Timing Marks
b - Index Marks

4. Install U-joint assembly into drive shaft housing. Apply Special Lubricant 101 to threads of ring nut and install. Torque ring nut to 200 lb. ft. (271 N·m).


22094

TORQUE CONVERSION CHART FOR U-JOINT RETAINER

Torque Wrench Length in Inches (mm) ⓐ	Torque Wrench Reading in Lb. Ft. (N·m) to Achieve 200 lb. ft. (271 N·m)
15 (381)	111 (151)
16 (406)	114 (155)
17 (432)	117 (159)
18 (457)	120 (163)
19 (483)	123 (167)
20 (508)	125 (170)
21 (533)	127 (172)
22 (559)	129 (175)
23 (584)	131 (178)
24 (610)	133 (180)
25 (635)	135 (183)
26 (660)	136 (184)
27 (686)	138 (187)
28 (711)	140 (190)
29 (737)	141 (191)
30 (762)	143 (194)
31 (787)	144 (195)
32 (813)	145 (197)
33 (838)	147 (200)
34 (864)	148 (201)
35 (889)	149 (202)
36 (914)	150 (203)



26363

a - Torque Wrench Length

TORQUING BRAVO U-JOINT BEARING RETAINER NUT

Use the following procedure to allow torquing retainer nut with a torque wrench.

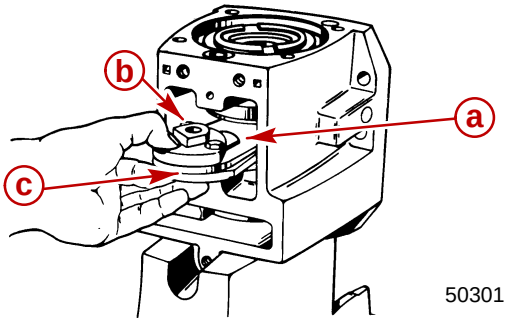
a. On beam-type torque wrenches, measure from square drive to fulcrum (pivot) point of handle.

b. On click-stop or dial type torque wrenches, measure from square drive to reference mark on handle (2 bands, etc.).

5. Check that timing marks are still properly aligned (by turning U-joint, if necessary). If marks have moved; remove U-joint assembly and start over beginning with step (3).

IMPORTANT: Refer to “Special Information” on page 23 if shift cam assembly is being replaced.

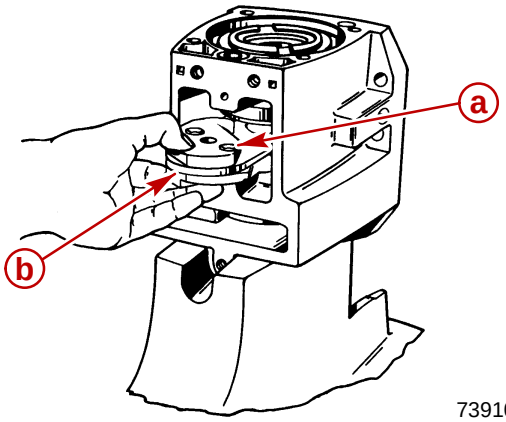
6. Install shift cam assembly into shifter cavity in drive shaft housing. Install later style shift cam assemblies with the boss facing the bottom of the drive shaft housing.



50301

Earlier Style Shift Cam Assembly

a - Shift Cam Assembly
b - Top Boss
c - Bottom Boss



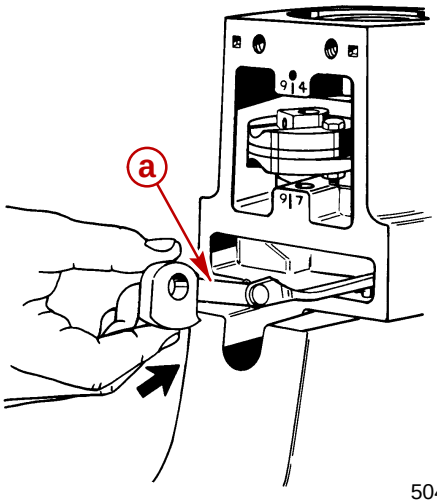
73910

Later Style Shift Cam Assembly

a - Shift Cam Assembly
b - Boss

7. Install shift linkage assembly.

   a. Push linkage assembly in. If linkage binds, move assembly gently from side to side while pushing.

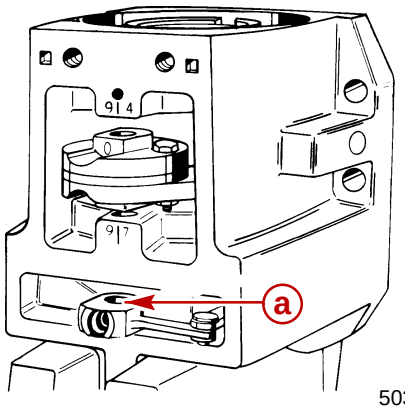


50400

a - Linkage Assembly

Index

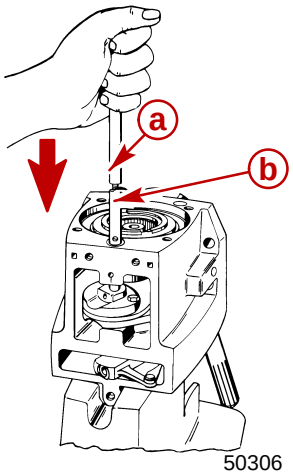
b. Turn linkage assembly 1/4 turn counterclockwise and position as shown.



50301

a - Linkage Assembly

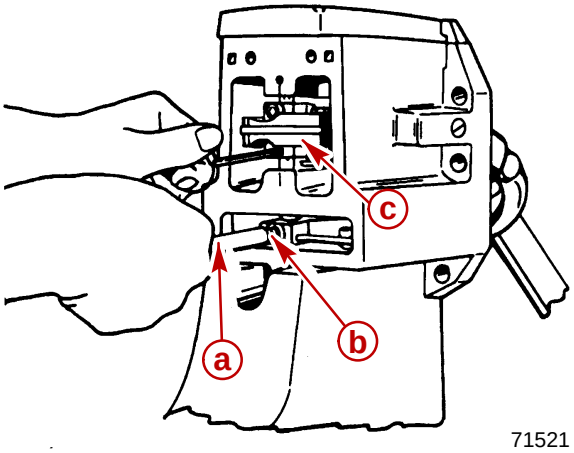
8. Install shift handle tool (P/N 91-17302) in shifter shaft and push shaft down. Remove tool.



50306

a - Shift Handle Tool
b - Shifter Shaft

9. Install shift handle tool through shift linkage and into shifter shaft. Move shifter shaft back and forth as necessary to align lower hole in shift cam assembly with threaded hole in shifter shaft. Apply Loctite 27131 to first 2 or 3 threads of screw, install shift cam cap screw and torque to 100-120 lb. in. (12-13 N·m).



71521

a - Shift Handle Tool
b - Shift Linkage
c - Shift Cam Assembly

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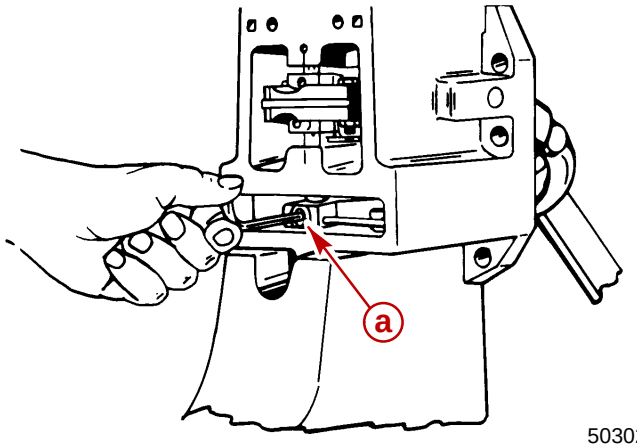
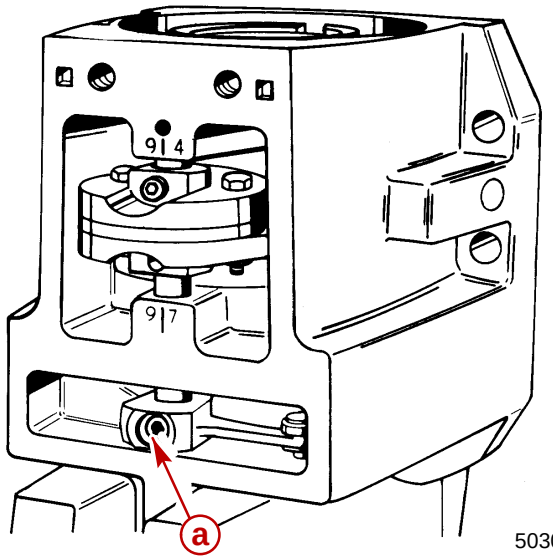
10. Apply Loctite 27131 to first 2-3 threads of shift linkage cap screw and install. Torque screw to 100-120 lb. in. (12-13 N·m).



50302

a - Cap Screw

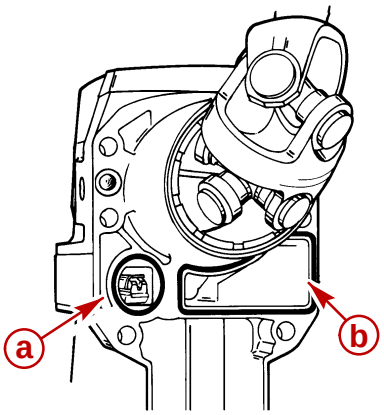
11. Move shift linkage to the neutral detent position as shown. Apply liberal amount of Special Lubricant 101 to I.D. of screw recess.



50301

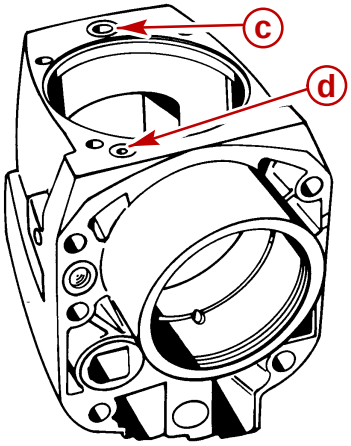
a - Screw Recess

12. Replace O-rings in drive shaft housing. Apply 3-M Adhesive (P/N 92-25234) to O-rings before installation.

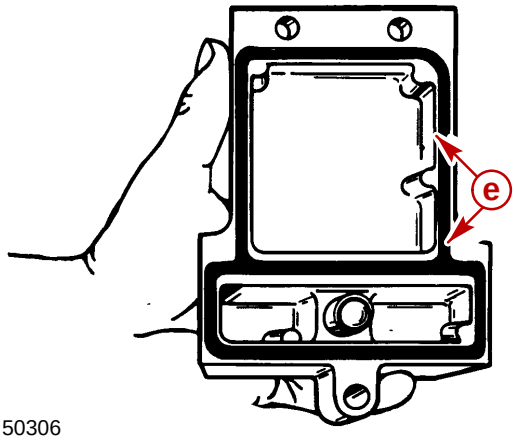


50356

a - Shift Linkage O-ring
b - Water Passage O-ring



50306



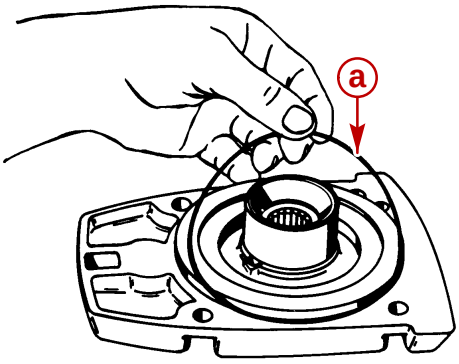
22100

c - Shifter Shaft O-ring
d - Oil Passage O-ring
e - Back Cover O-ring

IMPORTANT: <u>Earlier Style Units</u> – have a groove in the housing (no groove in the cover) to accept top cover O-ring seal.
<u>Later Style Units</u> – have a groove in the top cover (no groove in the housing) to accept the O-ring seal.

⚠ CAUTION

Do not interchange earlier style and later style covers/housings, as seal will leak, lowering drive fluid level in unit, which can result in damage to drive unit.



22088

a - Top Cover O-ring

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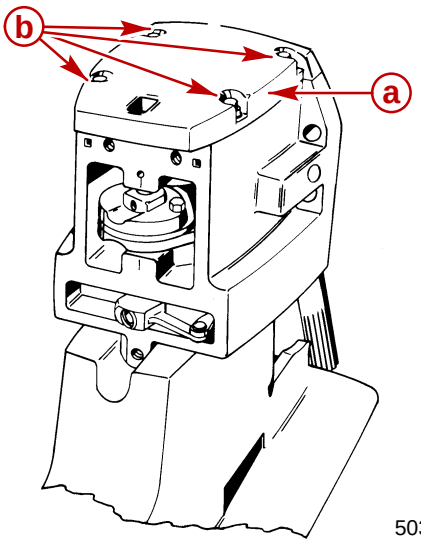
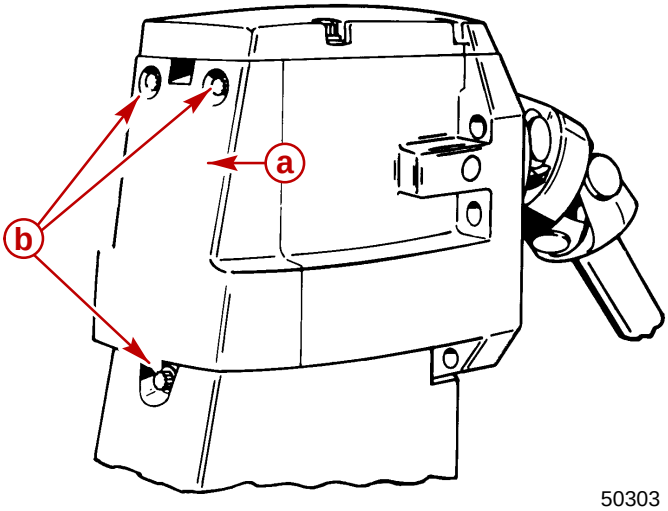
13. Install top cover. Torque screws to 18 - 22 lb. ft. (25 - 29 N·m).



50304

a - Top Cover
b - Screws

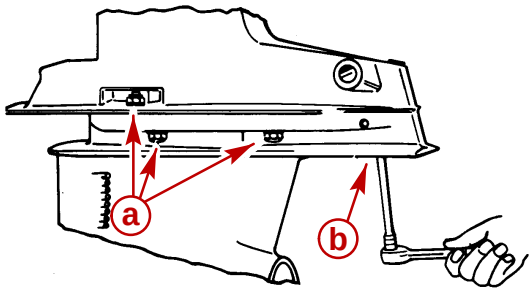
14. Install rear cover. Torque screws to 18 - 22 lb. ft. (25 - 29 N·m).



50303

a - Rear Cover
b - Screws

15. Install gear housing to drive shaft housing. Torque nuts and bolt to 35 lb. ft. (47 N·m).



22102

Bravo One

a - 6 Nuts and Washers
b - 1 Bolt (Located in Trim Tab Cavity)

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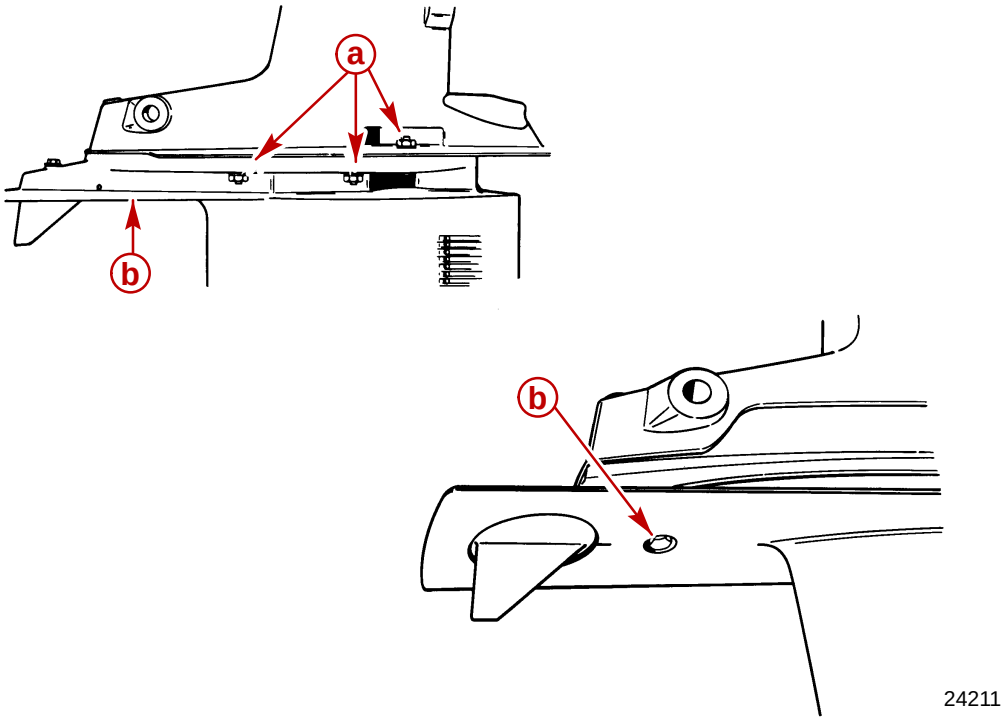
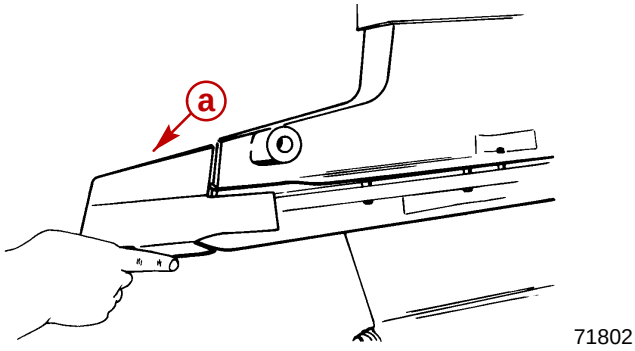


Bravo Two

a - 6 Nuts and Washers
b - 1 Bolt (Located in Front of Trim Tab)

NOTE: *Later style Bravo Three drive units have the splash plate extension incorporated into the gear housing.*

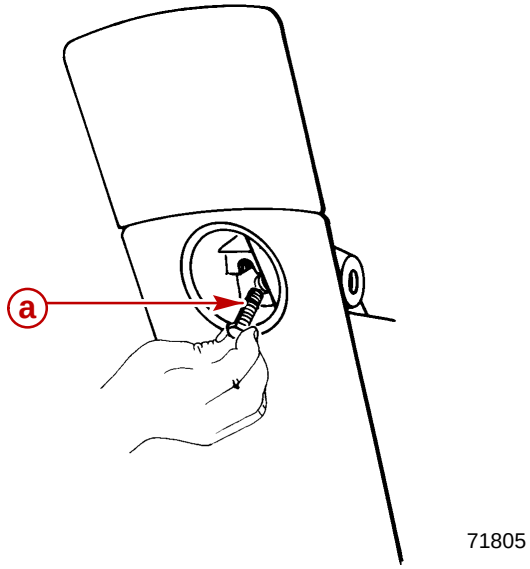
a. **If Applicable** - Slide the splash plate extension into the slot in the drive shaft housing.



Bravo Three

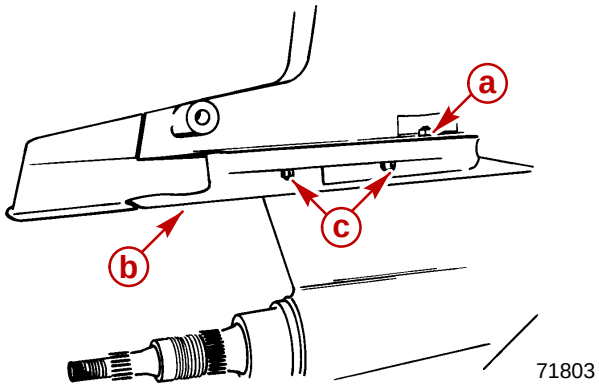
a - Splash Plate

b. Install the bolt in the anode cavity.



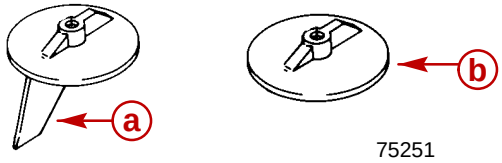
a - Bolt

c. Install the remaining fasteners. Torque nuts to 35 lb. ft. (47 N·m).



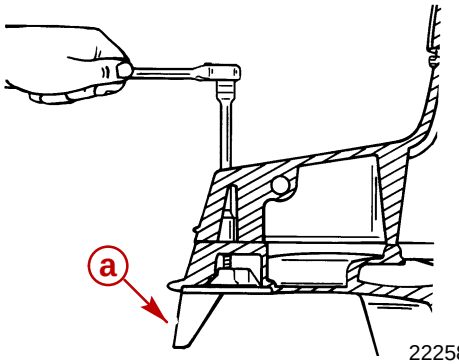
a - 6 Nuts and Washers
b - 1 Bolt

NOTE: *Later model Bravo One and Two drive units are equipped with an anodic plate instead of trim tab. Replacement procedure is the same.*

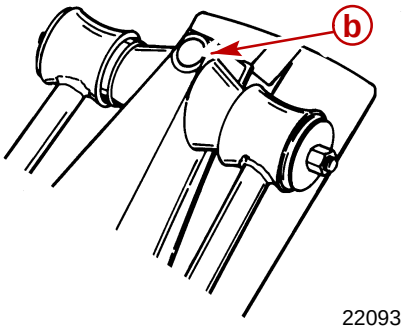


a - Trim Tab
b - Anodic Plate

16. **Bravo One and Two:** Install trim tab or anodic plate as applicable. If using trim tab, position it straight back. Torque to 23 lb. ft. (32 N·m). Install plastic plug on Bravo One and Bravo Three models.



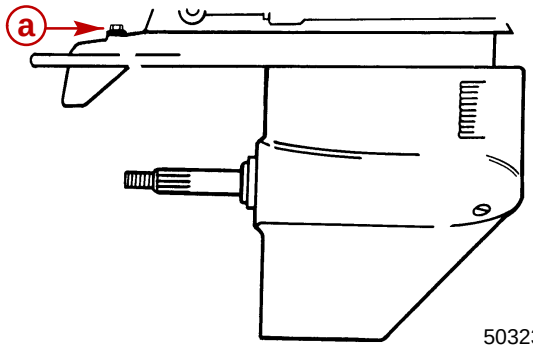
22258



22093

Bravo One

a - Trim Tab
b - Plastic Plug



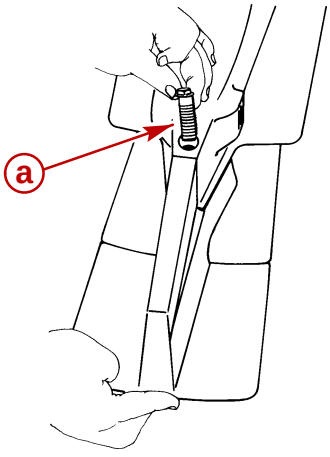
50323

Bravo Two

a - 1/2 in. Bolt

NOTE: *Earlier Bravo Three drive units were equipped with two anodic plates. The rear anode is attached with a bolt from the bottom side of the splash plate.*

17. **Bravo Three:** Install anodes as appropriate to model and torque all bolts to 23 lb. ft. (32 N·m). Install plastic plug.



71804

a - Bolt

18. Fill drive unit with gear lube. (Refer to Section 1B.)

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STERNDRIVE UNIT

Section 3B - Bravo One Gear Housing

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3 B

Specifications

Torque Specifications

DESCRIPTION	TORQUE		
	lb. in.	lb. ft.	N·m
Pinion Nut		100	135
Bearing Carrier Retainer	Torque to Proper Preload		
Drive Shaft Housing to Gear Housing Nuts and Bolt		35	48
Anodic Plate Screw		23	32
Oil Fill/Drain Plug	30-50		3.4-5.6

Preloads

DESCRIPTION	TORQUE	
	lb. in.	N·m
Driveshaft Bearings	3-5	0.3-0.8
Propeller Shaft Bearings - Checked at Propeller Shaft (New Bearings)	8-12*	0.9-1.4*
Propeller Shaft Bearings - Checked at Propeller Shaft (Used Bearings)**	5-8*	0.6-0.9*

*DOES NOT include 3 to 5 lb. in. (0.3-0.8 N·m) of preload on drive shaft bearings.
**A bearing is used if spun once under load.

Lubricants/Sealers/Adhesives

DESCRIPTION	PART NUMBER
Quicksilver High-Performance Gear Lube	92-816026A2
Quicksilver 2-4-C Marine Lubricant with Teflon	92-825407A12
Quicksilver Special Lubricant 101	92-13872A1
Quicksilver Needle Bearing Assembly Lubricant	92-825265A1
Perfect Seal	92-34227-1
3-M Adhesive	92-86166-1
Loctite 27131	92-809820
Quicksilver Engine Coupler Spline Grease	92-816391A4

Index

Special Tools

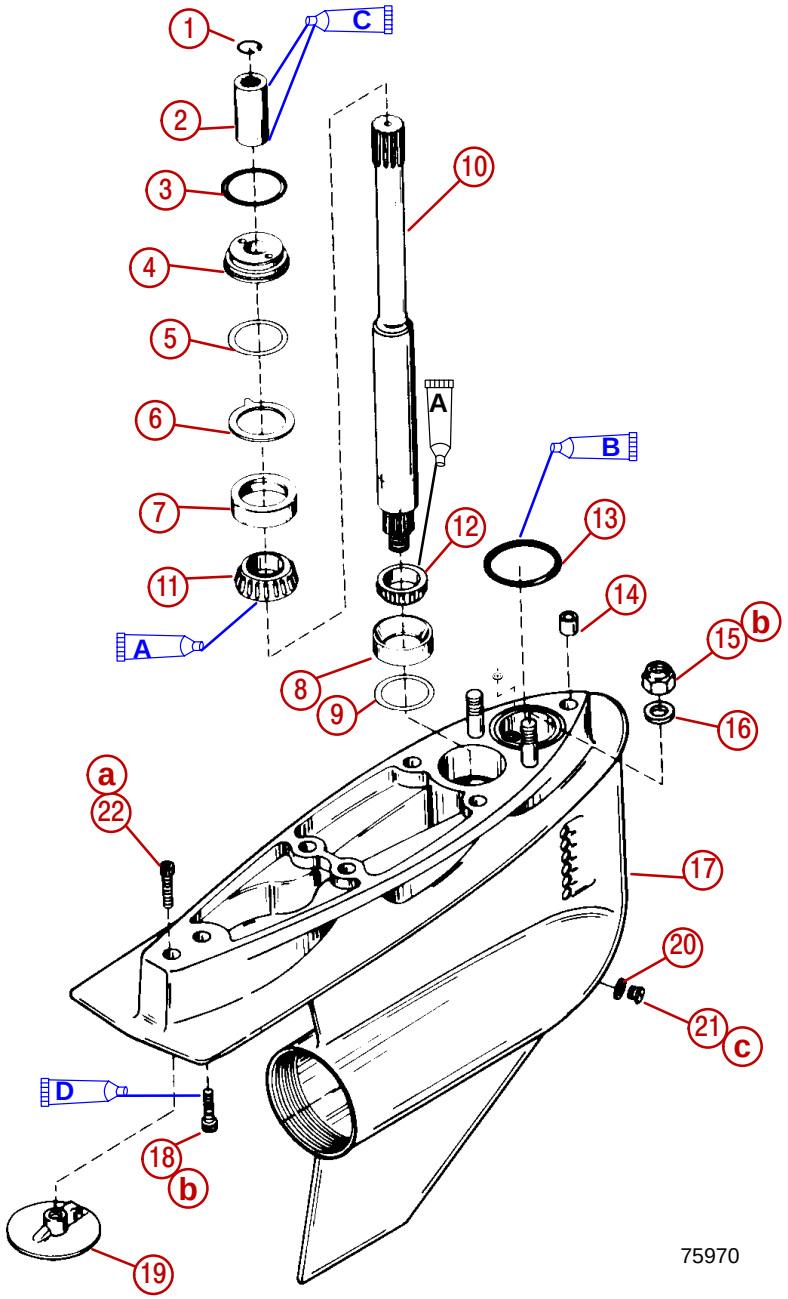
DESCRIPTION	PART NUMBER
Dial Indicator Set	91-58222A1
Backlash Indicator Rod	91-53459
Dial Indicator Adaptor Kit	91-83155
Slide Hammer Puller	91-34569A1
Torque Wrench (lb. in.)	91-66274
Drive Shaft Pinion Gear Shimming Tool	91-42840
Bearing Carrier Retainer Nut Wrench	91-61069
Bearing Carrier and Bar Puller	91-90338A1
Clamp Plate	91-43559
Drive Shaft Adaptor Tool	91-56775
Universal Puller Plate	91-37241
Bearing Seal Driver	91-89868
Threaded Rod	91-31229
Bearing Driver	91-89867
Bearing Carrier Seals and Bearing Cup Driver	91-89865
Bearing Cup Driver	91-31106
Bearing Cup Driver	91-67443
Driver Rod	91-37323
Bearing Removal Tool	91-63638
Bearing Adaptor Installation Tool	91-18605A2

Gear Ratio - Teeth per Gear (Gear Housing)

RATIO	PINION	DRIVEN
1.65:1	15	19
1.50:1	15	19
1.36:1	15	19

Bravo One Gear Housing Exploded View

Drive Shaft Components



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1 - Retainer
2 - Coupler
3 - O-Ring
4 - Spacer
5 - Shim(s)
6 - Tab Washer
7 - Bearing Cup
8 - Bearing Cup
9 - Shim(s)
10- Drive Shaft
11- Tapered Bearing (Larger Dia.)
12- Tapered Bearing (Smaller Dia.)
13- Seal Water Passage
14- Seal Speedometer Pitot Tube
15- Lock Nut
16- Flat Washer
17- Gear Housing
18- Screw
19- Anodic Plate
20- O-ring
21- Fill/Drain Screw
22- Screw

Lubricants, Sealers, and Adhesives

- Quicksilver High Performance Gear Lube 92-816026A4

- 3M Adhesive 92-86166-1

- Quicksilver 2-4-C Marine Lubricant with Teflon 92-825407A12

- Perfect Seal 92-34227-1

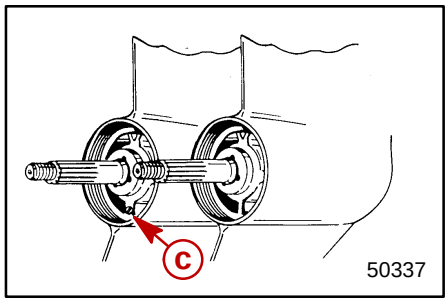
Torque Specifications

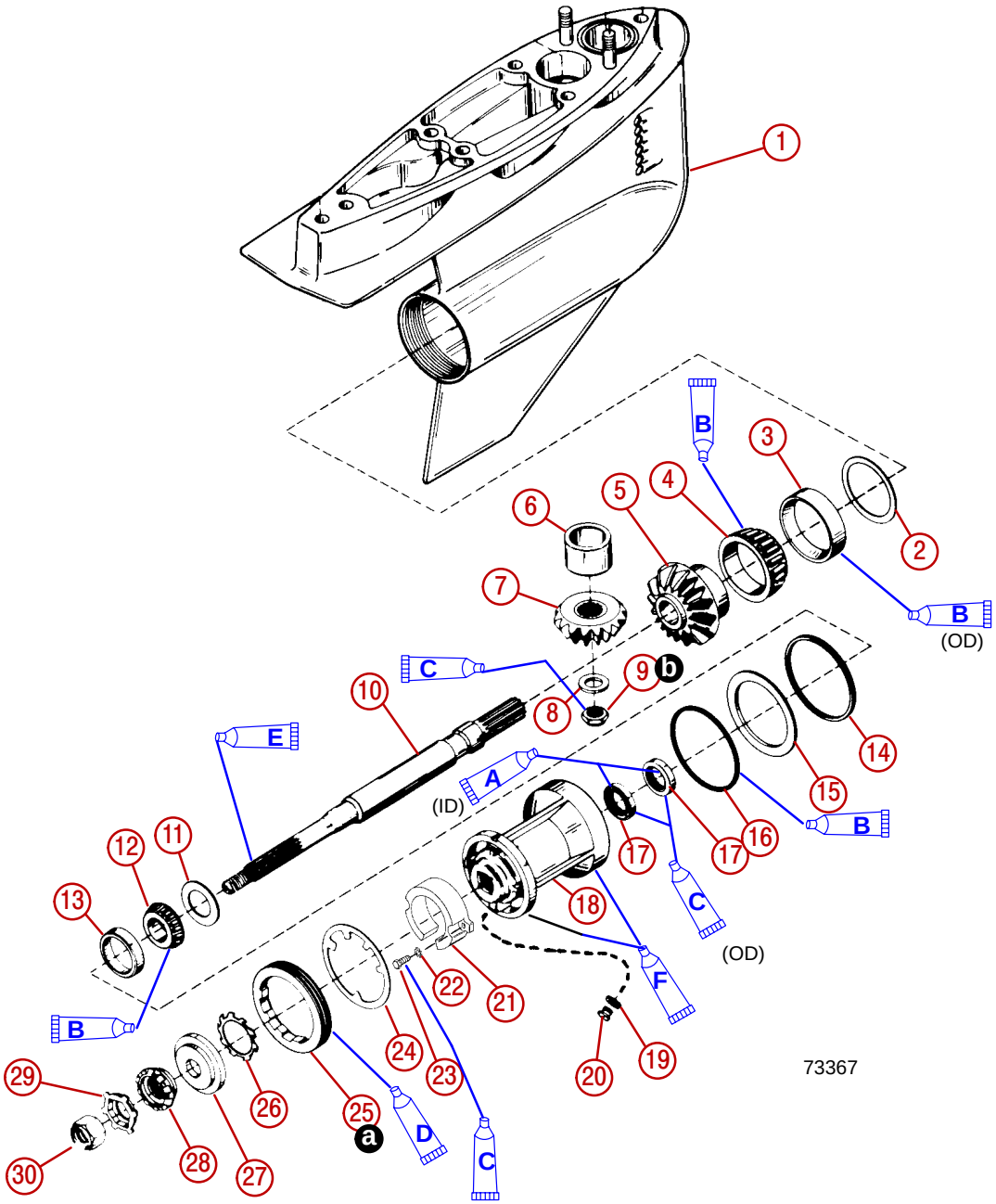
(a) 23 lb. ft. (32 N·m)

(b) 35 lb. ft. (47 N·m)

(c) 30-50 lb. in. (3.4-5.6 N·m)

Propeller Shaft Components





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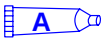
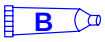
1 - Gear Housing
2 - Shims
3 - Bearing Cup
4 - Tapered Bearing
5 - Driven Gear
6 - Needle Bearing
7 - Pinion Gear
8 - Washer
9 - Locknut
10- Propeller Shaft
11- Washer
12- Tapered Bearing
13- Bearing Cup
14- Load Ring
15- Washer
16- O-ring
17- Seals
18- Bearing Carrier
19- Washer
20- Drain Screw
21- Propeller Anode
22- Lockwasher
23- Screw
24- Tab Washer
25- Bearing Carrier Retainer
26- Continuity Washer
27- Thrust Hub
28- Spline Washer
29- Tab Washer
30- Locknut

Lubricants, Sealers, and Adhesives



- Quicksilver 2-4-C Marine Lubricant with Teflon 92-825407A12



- Quicksilver High Performance Gear Lube (Use on All Bearing Surfaces) 92-816026A4

- Loctite 27131 92-809820

- Quicksilver Special Lubricant 101 . . . . . 92-13872A1

- Quicksilver Engine Coupler-Spline Grease 92-816391A4

- Perfect Seal 92-34227-1

Rolling Preload Specifications

(a) Tighten Until You Achieve Proper Gear Case Preload

Torque Specifications

(b) 100 lb. ft. (135 N·m)

(c) 30 - 50 lb. in. (3.4-5.6 N·m)

Special Note

(d) There are two models of bearing carriers, identical in size and installation, except that one is modified to include a drain plug, which is accessible when propeller is removed.

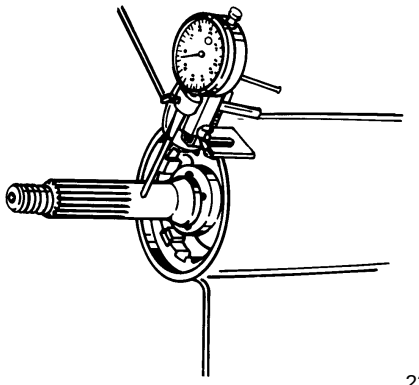
Gear Ratio - Teeth per Gear (Gear Housing)

RATIO	PINION	DRIVEN
1.65:1	15	19
1.50:1	15	19
1.36:1	15	19

Pre-Disassembly Inspection

1. Check propeller shaft for side to side movement, as follows:
   a. Position dial indicator on propeller shaft.
   b. Push propeller shaft to one side and zero the dial indicator.
   c. Move propeller shaft to opposite side while observing dial indicator. Without rotating propeller shaft, reposition dial indicator and check up and down deflection. A shaft deflection of more than .003 in. (0.08mm) indicates one of the following:

- Worn propeller shaft bearings.
- Improper propeller shaft preload.

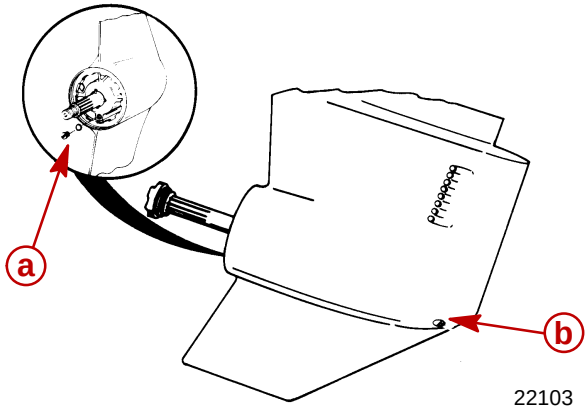


22086

2. Check for a bent propeller shaft, as follows:
   a. Rotate propeller shaft while observing dial indicator. If deflection is more than .005 in. (.127mm), a bent propeller shaft is indicated.

Drive Shaft Housing and Gear Housing Separation

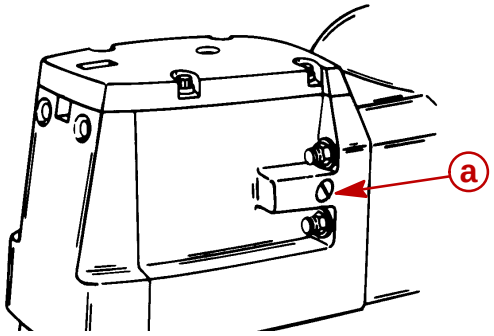
1. **Gear Lube Monitor models, only:** remove, empty, and clean gear lube monitor. Lubricate neck O-ring seal with gear lube before replacing monitor cap.
2. Drain drive unit at location “a” or “b,” as applicable.



22103

a - Fill/Drain Screw - Remove
b - Fill/Drain Screw - Remove

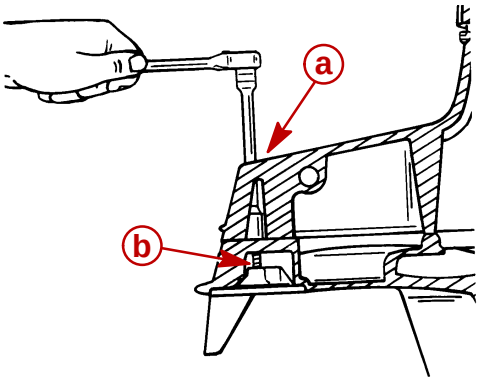
3. Remove vent plug.



50072

a - Vent Plug

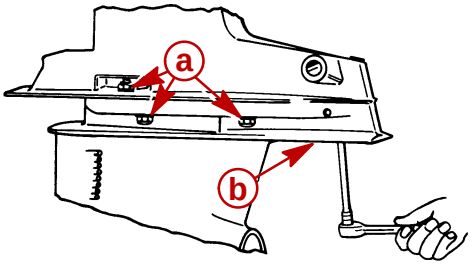
4. Remove trim tab or anodic plate.



22258

a - Plastic Plug - Removed
b - 1/2 in. Bolt - Remove

5. Remove gear housing from drive shaft housing.



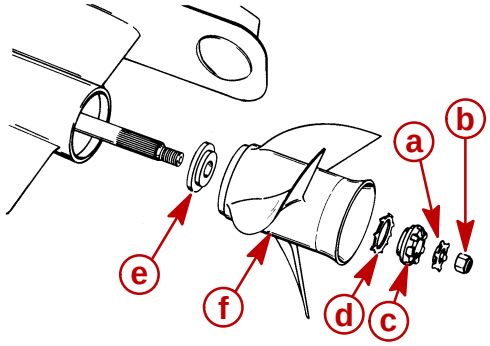
22102

a - 6 Nuts and Washers - Remove
b - 1 Bolt (Located in Trim Tab Cavity) - Remove

6. Finish draining gear case by turning upside down over container.

Gear Housing Disassembly

1. Remove propeller.



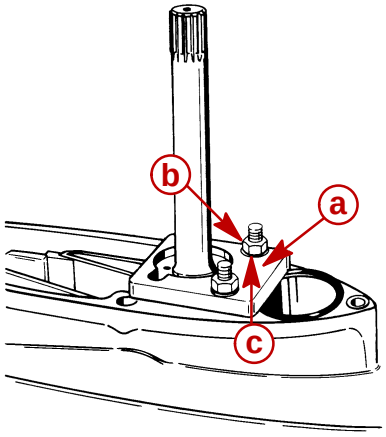
22166

a - Tab Washer - Bend Tabs
b - Nut - Remove
c - Spline Washer - Remove
d - Continuity Washer - Remove
e - Thrust Hub - Remove
f - Propeller

⚠ CAUTION

Clamp plate (91-43559) must be installed on gear housing when gear housing is separated from drive shaft housing.

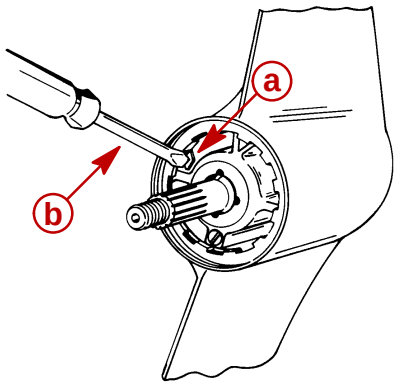
2. Install clamp plate on gear housing. Tighten securely.



22439

a - Clamp Plate
b - Nut
c - Washer

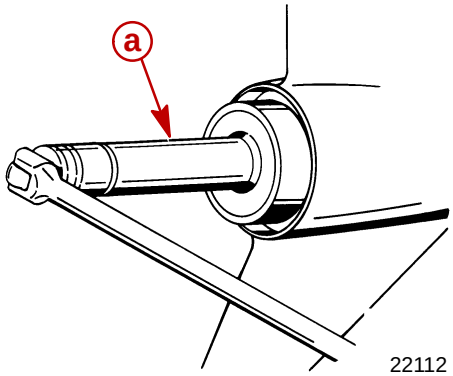
3. Bend tabs of tab washer away from bearing carrier retainer.



50136

a - Tab
b - Screw Driver

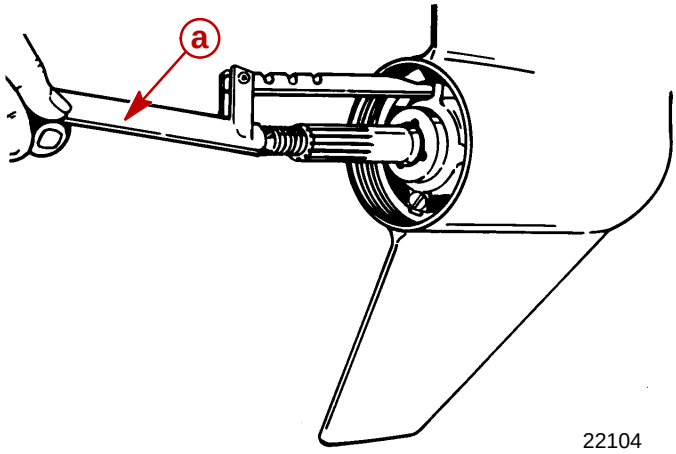
4. Remove bearing carrier retainer nut, using bearing carrier retainer wrench (91-61069).



22112

a - Bearing Carrier Retainer Wrench

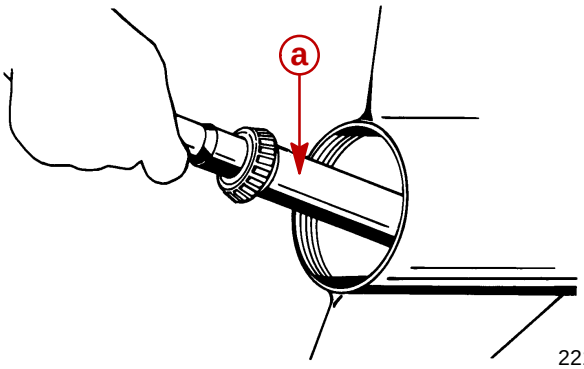
5. Remove bearing carrier with bearing carrier puller, (P/N 91-90339).



22104

a - Bearing Carrier Puller (91-90339)

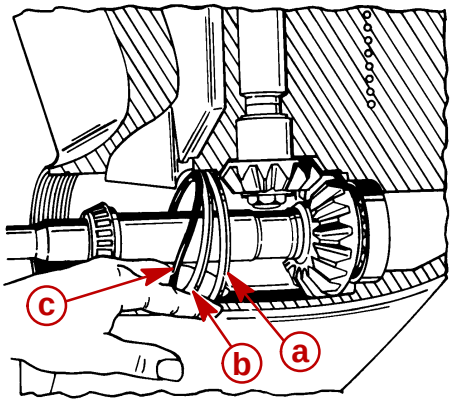
6. Remove propeller shaft.



22104

a - Propeller Shaft

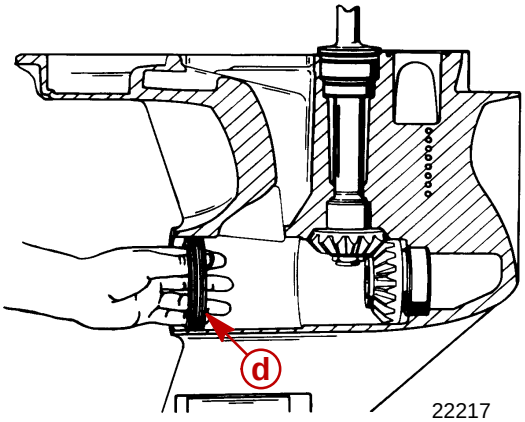
7. Remove washer, shims and O-ring.



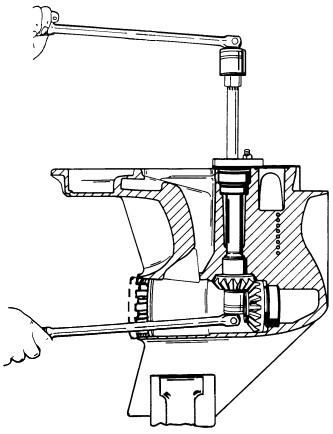
22111

a - Washer
b - Shims
c - O-ring

8. By hand, temporarily reinstall bearing carrier retainer in gear housing to protect housing threads. Remove pinion gear, nut, and washer.



22217

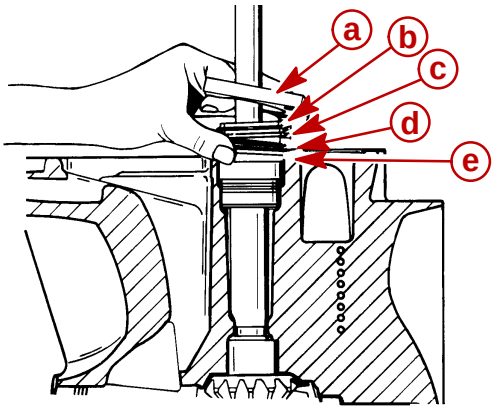


75921

a - Drive Shaft Adaptor Tool (91-61077)
b - Breaker Bar and Socket
c - Pinion Gear
d - Bearing Carrier Retainer

Index

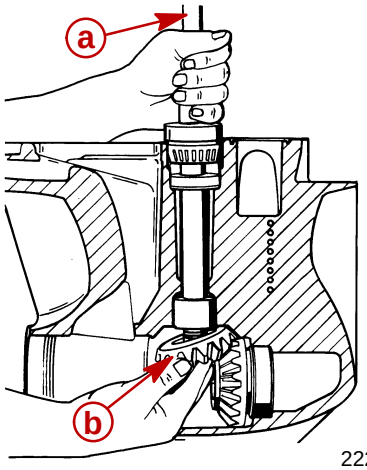
9. Remove clamp plate (installed in Step 2), then remove O-ring, spacer, shim(s) and tab washer.



22262

a - Clamp Plate
b - O-ring
c - Spacer
d - Shim(s)
e - Tab Washer

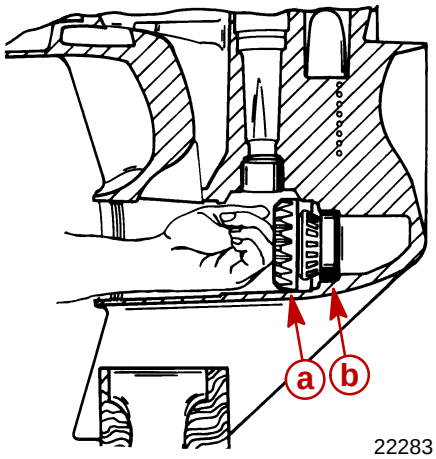
10. Remove drive shaft and pinion gear.



22259

a - Drive Shaft - Pull Up
b - Pinion Gear

11. Remove driven gear and bearing.

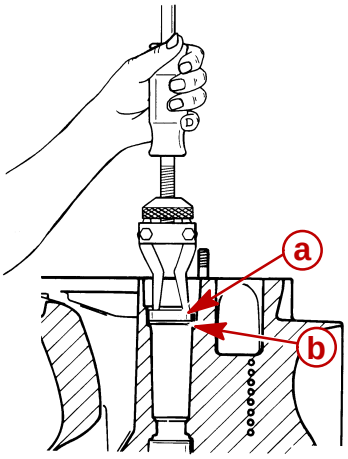


22283

a - Driven Gear
b - Bearing Cup

Index

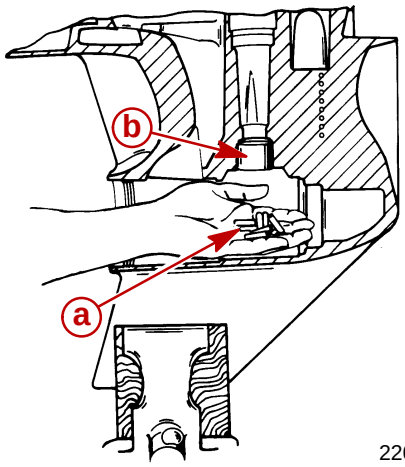
12. Remove drive shaft bearing cup and shims.



22261

a - Drive Shaft Bearing Cup
b - Shims

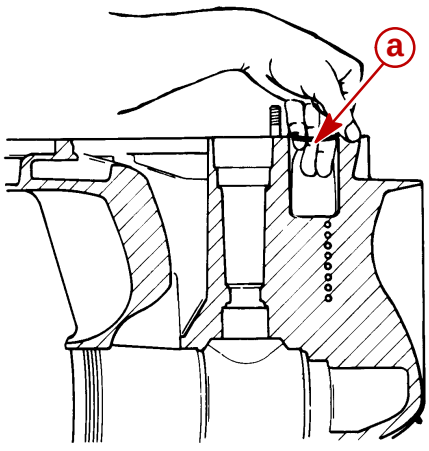
13. Unless you plan to remove the pinion bearing, remove needle bearings from drive shaft needle bearing race. (See Pinion Bearing Removal on page 3B-16.)



22083

a - Needle Bearings
b - Drive Shaft Needle Bearing Race

14. Remove water passage O-ring.



22222

a - Water Passage O-ring

Component Servicing

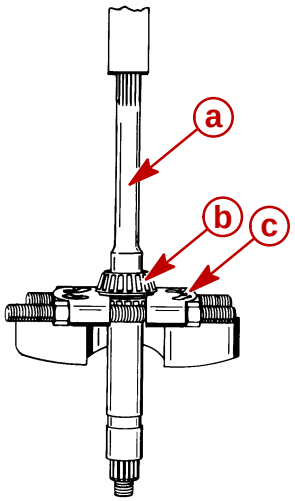
Drive Shaft and Pinion Bearing Inspection and Cleaning

1. The condition of the drive shaft tapered bearing cups is an indication of the condition of the tapered roller bearings on the drive shaft. Replace bearing and bearing cup if cup is pitted, grooved, scored, worn uneven, discolored from overheating, or has embedded metal particles.
2. The condition of the bearing surface on drive shaft at needle bearing location is an indication of the condition of needle bearings. Replace needles and sleeve if pitted, grooved, scored, worn uneven, discolored from overheating, or has embedded metal particles.
3. Inspect splines for worn or twisted condition. Replacement of drive shaft is necessary if either condition exists.
4. Clean all parts that are to be reused with solvent. Dry parts completely using compressed air, being careful not to spin bearings.

Drive Shaft Disassembly

NOTE: *Bearing assembly must be replaced if removed from drive shaft. Tapered roller bearings are damaged when removing.*

1. Press tapered roller bearing from shaft using universal puller plate (91-37241) to support bearing. Remove second tapered roller bearing in same manner.



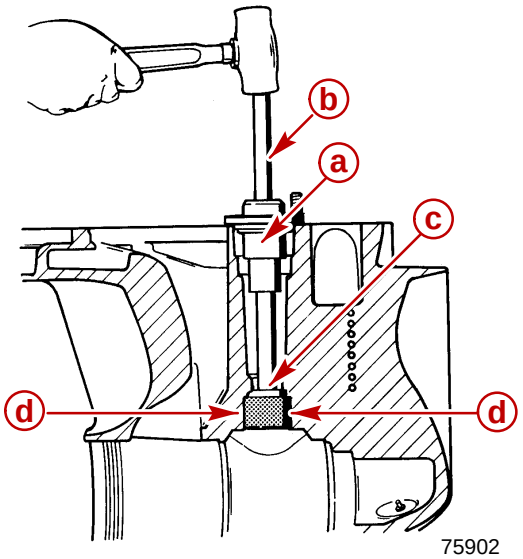
22109

a - Drive Shaft
b - Bearing
c - Universal Puller Plate

Pinion Bearing Removal

IMPORTANT: All needle bearings MUST BE in place inside bearing casing while driving pinion bearing from gear case or bearing casing will bend or break and become difficult to remove.

1. Remove pinion bearing.

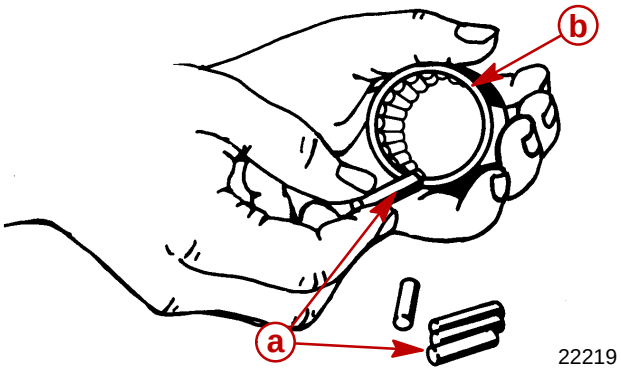


75902

a - Bearing Driver (91-89868) - Used as Pilot
b - Driver Rod (91-37323)
c - Bearing Remover (91-63638) - Ensure Tabs Align with Slots in Gear Housing
d - Heat Bearing Area of Housing to approximately 200°F (99°C) to Assist in Bearing Removal. DO NOT use Open Flame

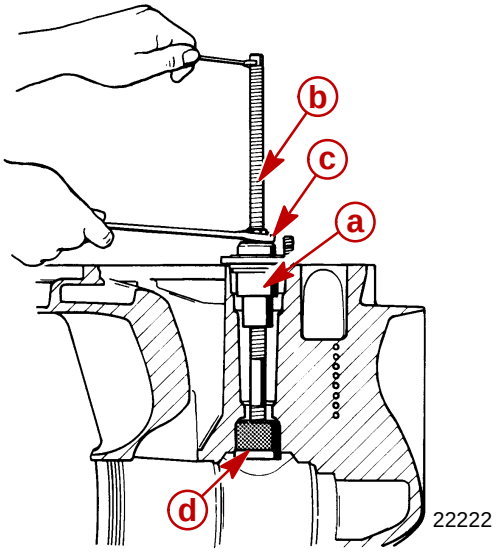
Pinion Bearing Installation

1. Install needles in casing. Use Needle Bearing Assembly Lubricant to help keep needles in place. Position bearing assembly over bearing installation tool with number on bearing casing facing up. Coat casing O.D. with Gear Lube.



a - Needle Bearings
b - Casing

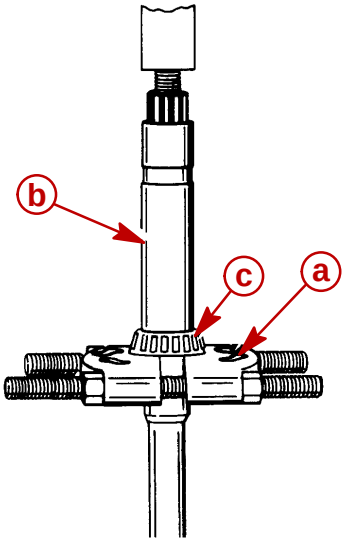
2. Install pinion bearing using tools as shown. Install the bearing with the serial number on the race facing up.



a - Bearing Driver (91-89868) - Used as Pilot
b - Threaded Rod (91-31229)
c - Washer and Nut - Turn Clockwise
d - Bearing Driver (91-89867)

Drive Shaft Reassembly

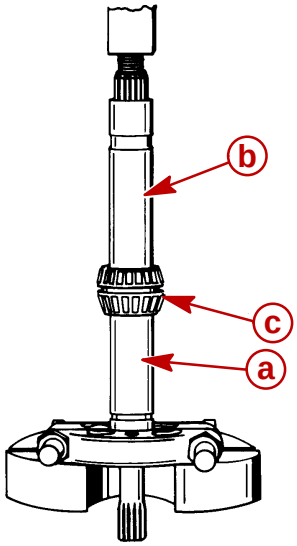
1. Press small tapered roller bearing onto drive shaft. Ensure smaller O.D. faces pinion end of shaft.



22109

a - Universal Puller Plate
b - Drive Shaft
c - Small Tapered Roller Bearing

2. Press large tapered roller bearing onto drive shaft. Ensure larger O.D. faces pinion end of shaft.



22109

a - Suitable Mandrel - Support on Inner Bearing Race
b - Drive Shaft
c - Large Tapered Roller Bearing

Bearing Carrier Inspection

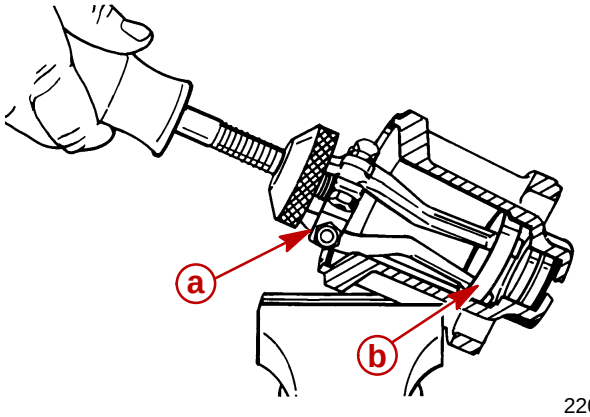
1. The condition of the propeller shaft tapered roller bearing cup is an indication of the condition of tapered roller bearing on propeller shaft. Replace bearing and cup if cup is pitted, grooved, scored, worn, uneven, discolored from overheating or has embedded metal particles.
2. Check bearing carrier for signs of corrosion, especially on gear housing to bearing carrier mating surfaces. If corrosion is evident, replace bearing carrier.

Bearing Carrier Servicing

DISASSEMBLY

NOTE: *Oil seals and bearing cup may be removed and replaced individually. It is not necessary to remove bearing cup to replace oil seals or remove oil seals to replace bearing cup.*

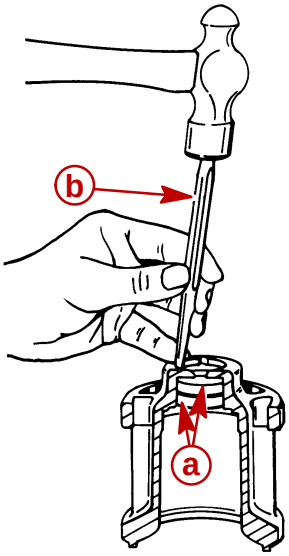
1. Remove bearing cup.



22087

a - Slide Hammer Puller
b - Bearing Cup

2. Remove oil seals from bearing carrier.

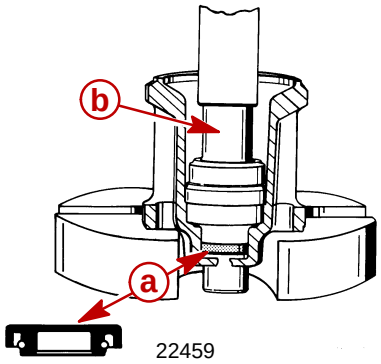


22111

a - Oil Seals (2)
b - Punch

REASSEMBLY

1. Coat O.D. of oil seal with either Loctite Type “A” or 27131. Install outer oil seal with lip facing outward.

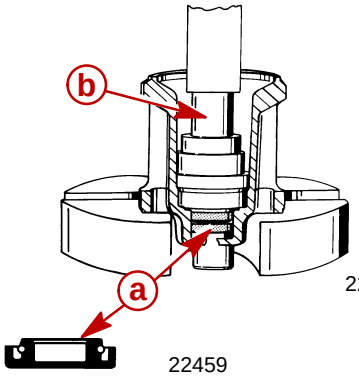


22087

22459

a - Oil Seal - Lip Outward
b - Cup and Seal Driver (91-89865)

2. Coat O.D. of oil seal with Loctite 27131 or Type “A”. Install inner oil seal with lip facing inward.

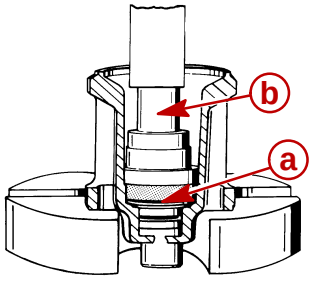


22088

22459

a - Oil Seal - Lip Inward
b - Cup and Seal Driver (91-89865)

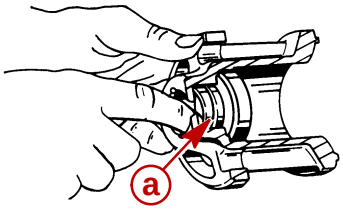
3. Install bearing cup with bearing surface inward.



22088

a - Bearing Cup
b - Cup and Seal Driver (91-89865)

4. Fill area between seals with 2-4-C Marine Lubricant with Teflon.



22111

a - Area Between Seals

Index

Propeller Shaft Inspection

1. Check propeller shaft for bent condition. Use either method following:

LATHE AND DIAL INDICATOR METHOD:

a. Position propeller shaft centers in lathe.

b. Mount dial indicator at front edge of propeller shaft.

c. Rotate shaft and observe dial indicator. Movement of more than .005 in. (.127mm) is reason for replacement.

V-BLOCKS AND DIAL INDICATOR METHOD:

d. Position propeller shaft bearing surfaces on V-blocks.

e. Mount a dial indicator at front edge of propeller shaft.

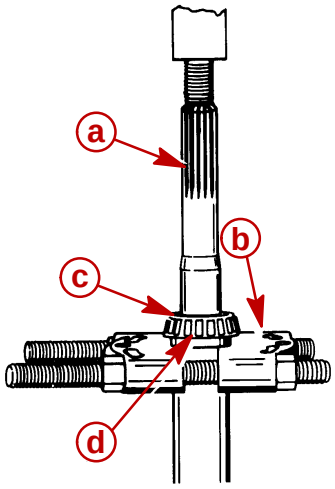
f. Rotate shaft and observe dial indicator. Movement of more than .005 in. (.127mm) is reason for replacement.

2. Inspect for bent or twisted splines.

3. Inspect surface of shaft where bearing carrier oil seal lips contact shaft. Oil seals will have to be replaced if any grooves are found.

Propeller Shaft Bearing Removal

1. Press bearing from propeller shaft. Remove washer.

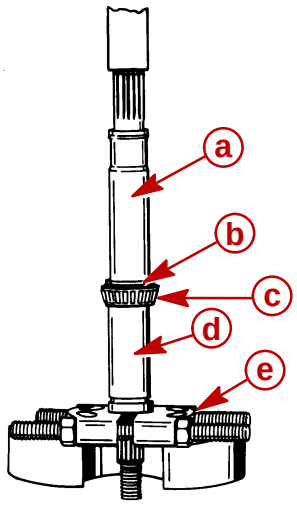


22110

a - Propeller Shaft
b - Universal Puller Plate (91-37241)
c - Tapered Roller Bearing
d - Washer

Propeller Shaft Bearing Installation

1. Install washer on shaft. Apply Gear Lube to I.D. of new bearing. Install bearing to shaft using universal puller plate and a suitable mandrel (old bearing race) which supports bearing on inner race. Press into place.



22110

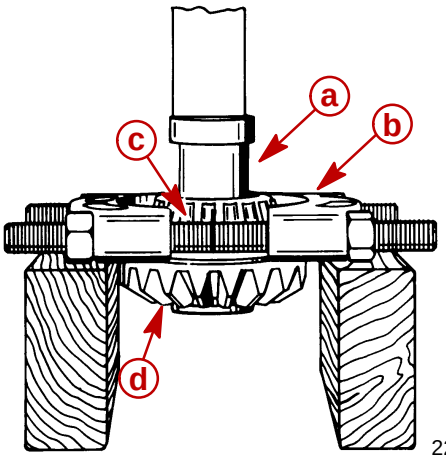
a - Propeller Shaft
b - Washer
c - Tapered Roller Bearing
d - Suitable Mandrel
e - Universal Puller Plate (91-37241)

Driven Gear Bearing Removal and Inspection

1. Remove bearing from driven gear. Inspect both the driven gear and the pinion gear for pitting, chipped or broken teeth and excessive or uneven wear. Replace both gears if any of these conditions exist.
2. Replace tapered roller bearing and cup if cup is pitted, grooved, scoured, worn uneven, discolored from overheating, or has metal particles embedded in the cup.

Driven Gear Bearing Removal

1. Remove bearing from driven gear.



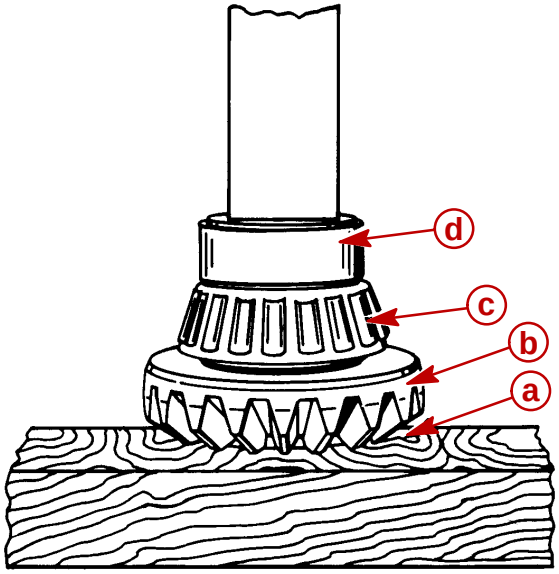
22108

a - Suitable Mandrel
b - Universal Puller Plate
c - Bearing
d - Driven Gear

Index

Driven Gear Bearing Installation

1. Apply a light coat of Gear Lube to I.D. of new bearing. Place a suitable mandrel (old bearing race) against new bearing race. Place another mandrel on face of gear and press gear and bearing together.

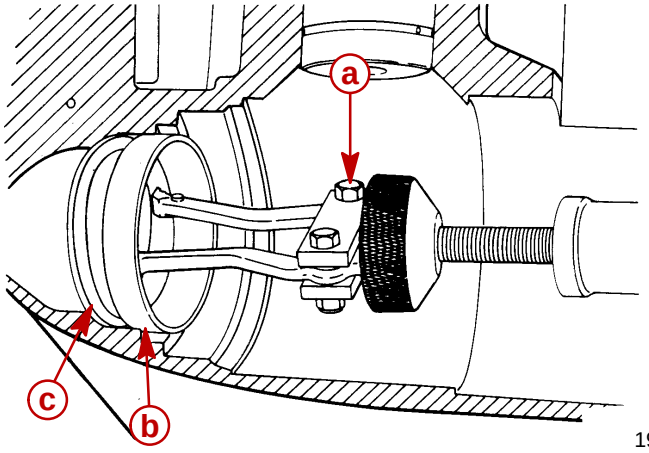


22108

a - Hard Wood or Metal Block
b - Driven Gear
c - Tapered Roller Bearing
d - Mandrel - Contacting Inner Race

Driven Gear Bearing Cup Removal and Inspection

1. Remove bearing cup and shims. Replace tapered roller bearing and cup if cup is pitted, grooved, scored, worn uneven, discolored from overheating, or has metal particles embedded in the cup.

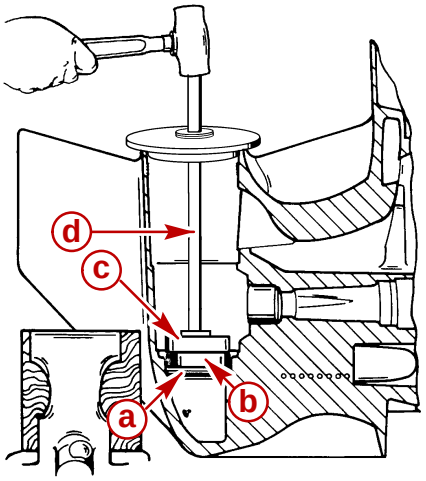


19808

a - Slide Hammer Puller (91-34569A1)
b - Bearing Cup
c - Shims

Driven Gear Bearing Cup Installation

1. Install driven gear bearing cup with original thickness shims(s). Ensure cup is not canted. Coat cup O.D. with Gear Lube.

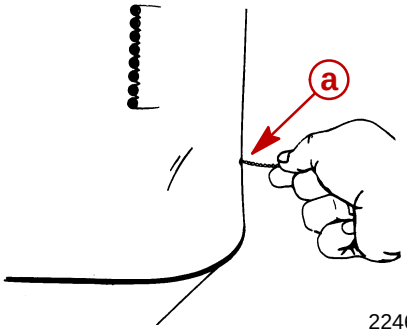


75922

a - Shim(s)
b - Bearing Cup
c - Driver (P/N 91-31106)
d - Old Propeller Shaft or Driver Rod

Speedometer Water Tube Pickup Inspection and Cleaning

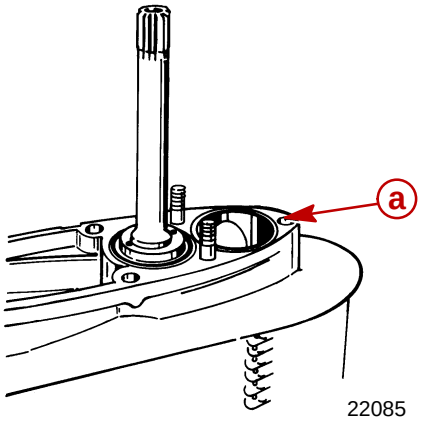
1. Inspect opening (pitot tube), on leading edge of gear housing, for obstruction. Clean opening with a short piece of wire, if necessary. If obstruction can not be removed with wire, carefully reopen tube using a 5/64 in. (2mm) diameter drill bit. Do not drill beyond a depth of 2-7/16 in. (62mm).



22462

a - Pitot Tube

2. Inspect water tube seal for nicks, cuts, or distortion. Replace if necessary.



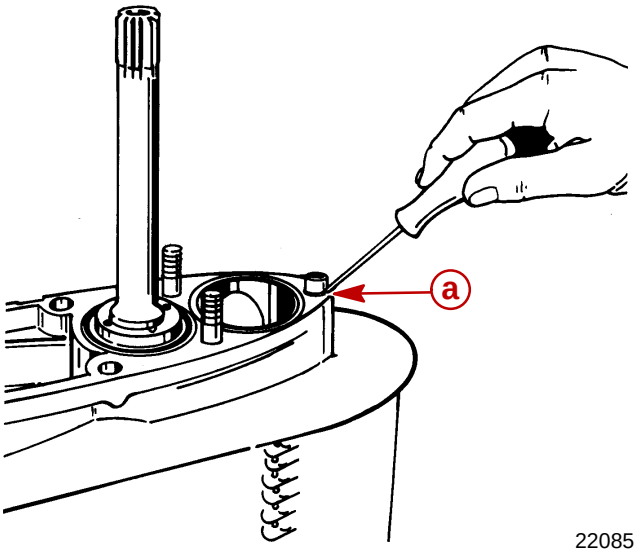
22085

a - Water Tube Seal

Index

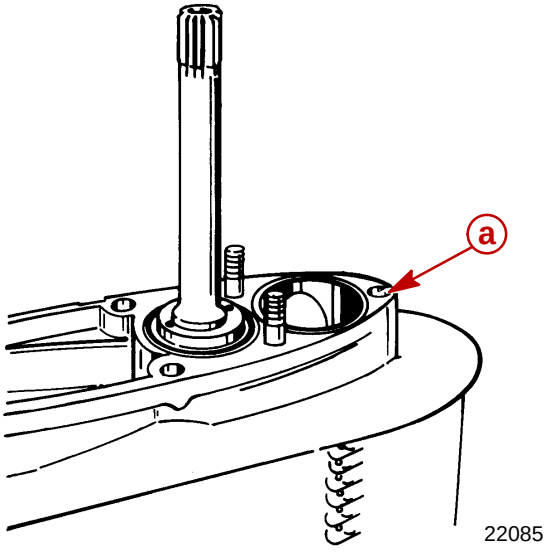
Speedometer Water Tube Seal Replacement

1. Pry rubber seal out with a suitable tool.



a - Rubber Seal

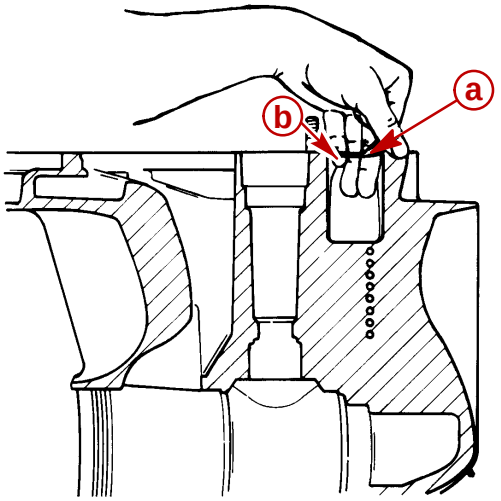
2. Lightly coat O.D. of seal with 3-M adhesive (92-86166--1) and install in speedometer water tube bore. Ensure top edge of seal is flush with gear housing surface.



a - Seal

Gear Housing Reassembly and Shimming

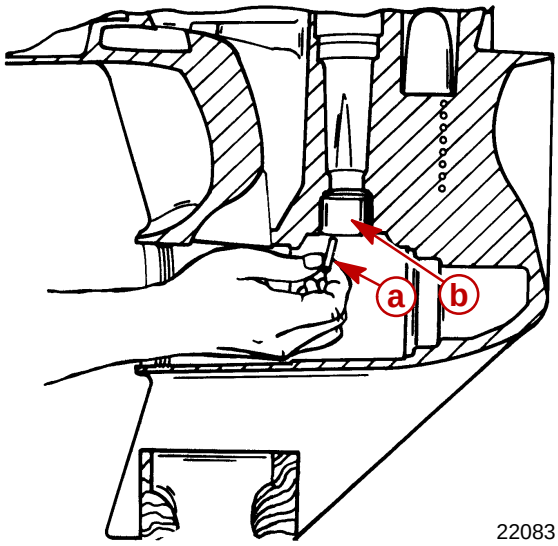
1. Lubricate all gears and bearings with gear lube before installing. Components must be lubricated to obtain accurate bearing preload readings.
2. Install water passage O-ring and oil passage quad ring. Hold in place using 3-M adhesive (P/N 92-86166--1).



22222

a - O-ring
b - Oil Passage Quad Ring

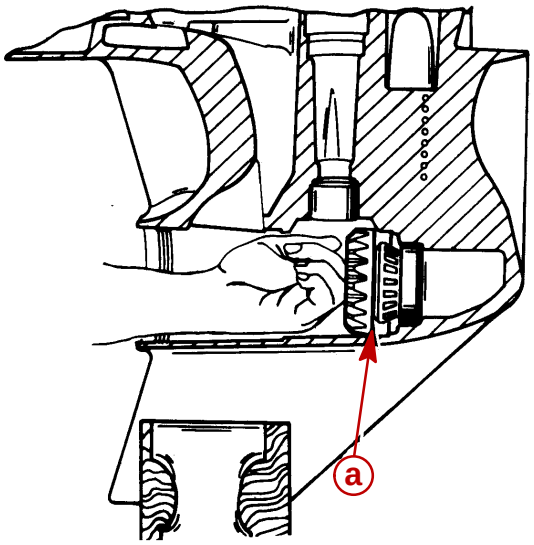
3. Install needle bearings into lower needle bearing casing. Use Needle Bearing Assembly Lubricant to hold needle bearings in place.



22083

a - Needle Bearings
b - Needle Bearing Casing

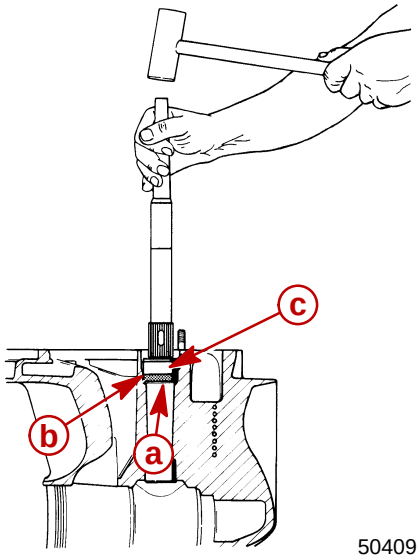
4. Install driven gear assembly.



22083

a - Driven Gear Assembly

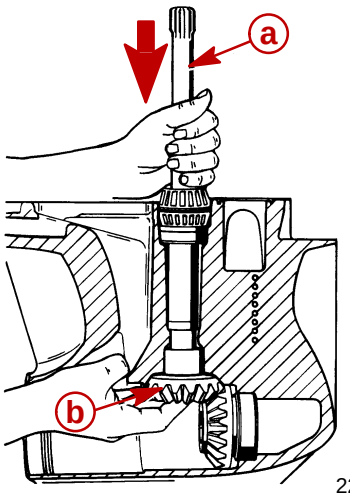
5. Install original shim(s) and drive shaft lower bearing cup, using cup driver (P/N 91-67443). Use original shims, or if lost or misplaced, start with .050 in. (1.27mm) thickness.



50409

a - Shim(s)
b - Lower Bearing Cup
c - Cup Driver

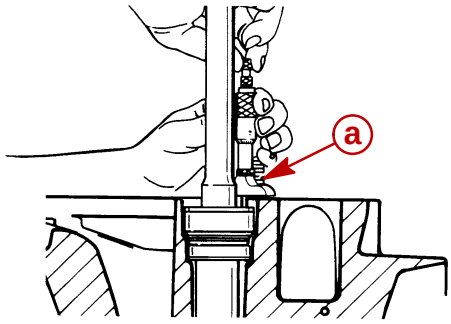
6. Install drive shaft and pinion gear.



22258

a - Drive Shaft
b - Pinion Gear

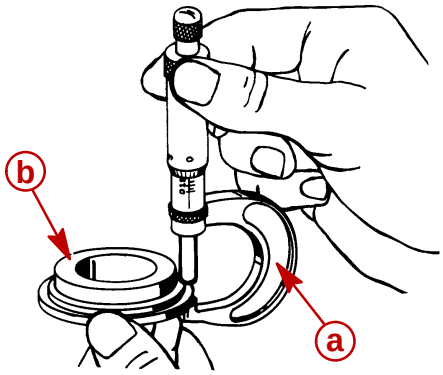
7. Determine shim thickness required for drive shaft bearing preload.
   a. Measure distance between top of gear housing and tab washer.



22259

a - 0-to-1 in. Depth Micrometer

   b. Measure thickness of spacer from top machined surface to bottom machined surface.



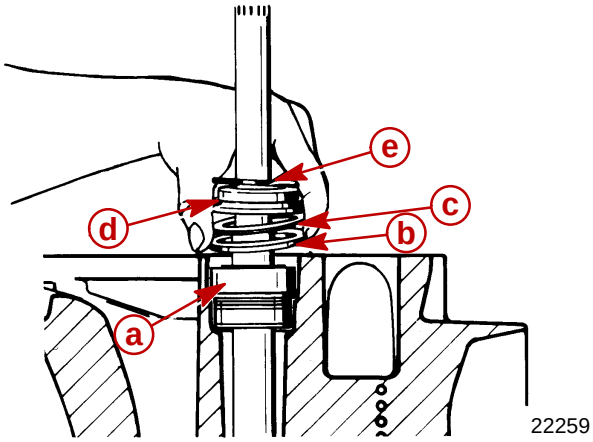
22100

a - Outside Micrometer
b - Spacer

   c. Calculate shim thickness as shown.
   Measurement “step a” – Measurement “step b” + .001 in. = Shim Thickness Required.

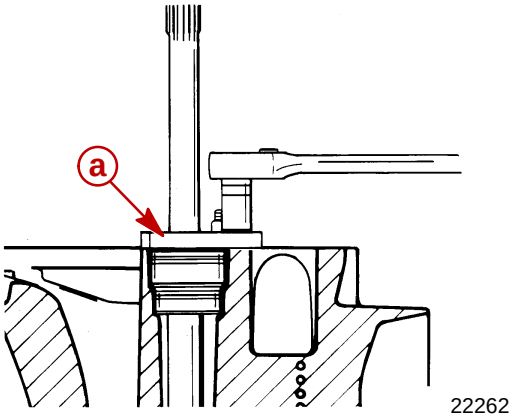
Index

8. Install upper bearing cup, tab washer, original shims, spacer, and O-ring.



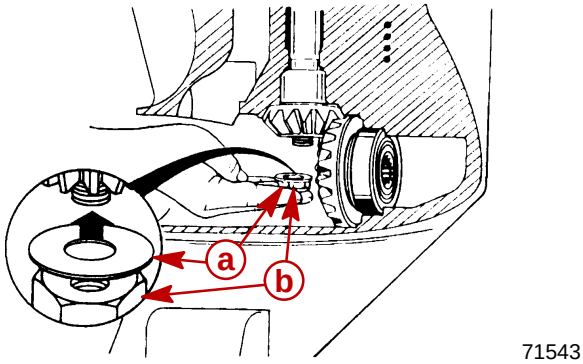
a - Upper Bearing Cup
b - Tab Washer
c - Original Shims
d - Spacer
e - O-ring

9. Install clamp plate (P/N 91-43559) on gear housing with 4 nuts and washers. Torque to 35 lb. ft. (47 N·m).



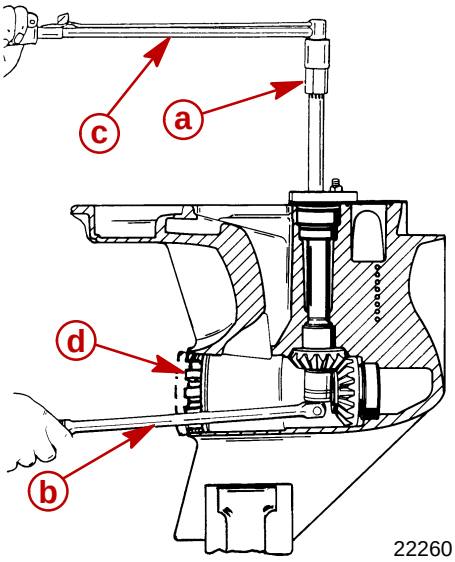
a - Clamp Plate

10. Install washer, and apply either Loctite 27131 to threads of new nut.



a - Washer
b - Nut

11. Temporarily install bearing carrier retaining nut to avoid damage to threads. Torque pinion nut to 100 lb. ft. (135 N·m).

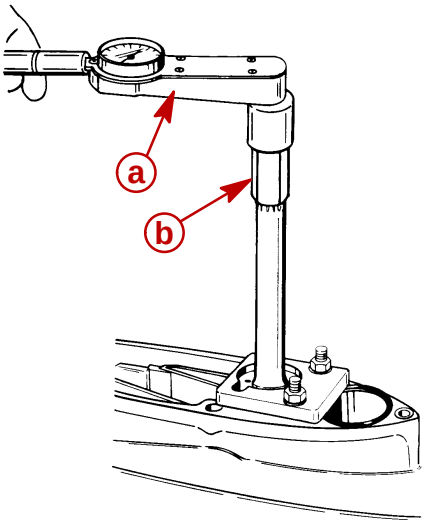


22260

a - Drive Shaft Adaptor Tool (91-61077)
b - Breaker Bar and Socket
c - Torque Wrench and Socket
d - Bearing Carrier Retainer

12. By hand, remove bearing carrier retainer previously placed in unit for protection of threads.

13. Using a dial-type lb. in. torque wrench, check the rolling preload [3-5 lb. in. (0.3-0.6 N·m)].



50410

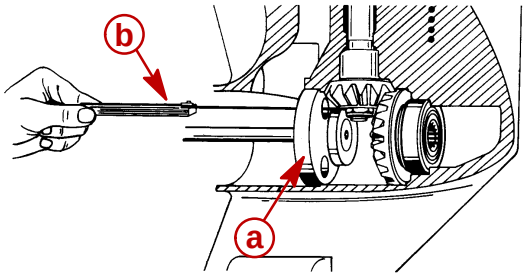
a - Dial-type lb. in. Torque Wrench
b - Drive Shaft Adaptor

14. If too tight or loose, adjust as required.

15. Check pinion height.

    a. Insert shimming tool into gear housing.

    b. Measure clearance between tool and gear with feeler gauge. Clearance must be .025 in. (.635mm). Take measurement at 3 locations on gear (120 degrees apart).

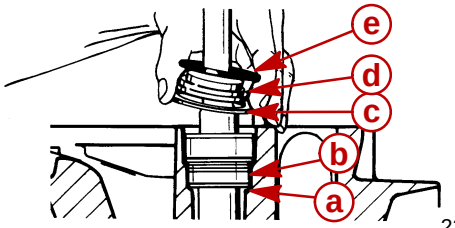


50370

a - Shimming Tool (P/N 91-42840)
b - Feeler Gauge

    c. If clearance is less than specified: Add appropriate thickness of shim(s) under lower tapered roller bearing cup. **Any thickness added here must be subtracted from shim thickness at upper bearing.**

    If clearance is more than specified: Remove appropriate thickness of shim(s) from under lower tapered roller bearing cup.

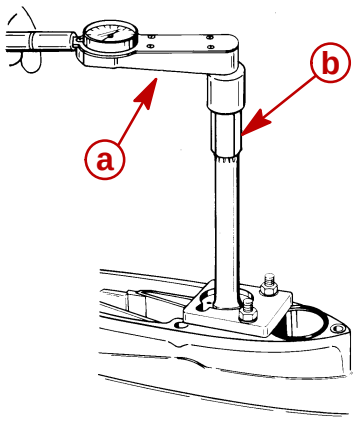


22262

a - Shims, Lower
b - Bearing Cup, Lower
c - Shims, Upper
d - Spacer
e - O-ring

    d. Recheck clearance after changing shim(s) in step “b,” above.

16. Using a dial-type (lb. in.) torque wrench, check the rolling preload [3-5 lb. in. (0.3-0.6 N·m)].



50410

a - Dial-type lb. in. Torque Wrench
b - Drive Shaft Adaptor

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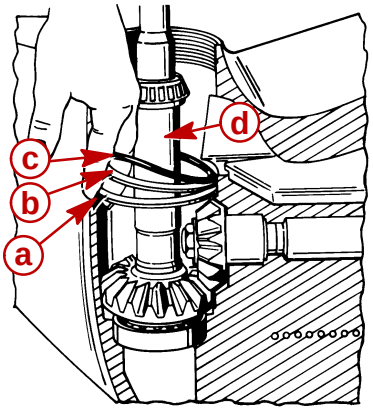
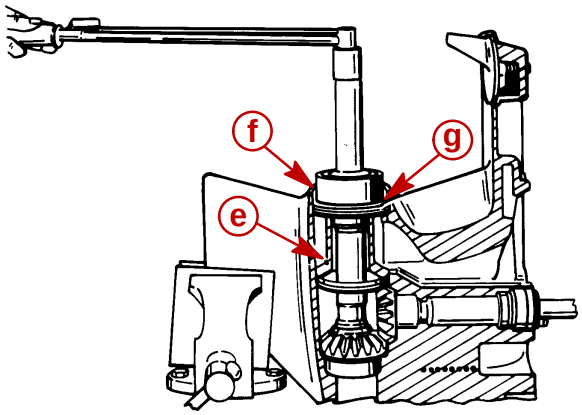
Driven Gear Shimming for Models with Shims

NOTE: *Bravo One drives with serial numbers OD782690 and higher use a load ring instead of shims. See “Driven Gear Shimming for Models Using Load Ring”, on page 3B-37.*

1. Install washer, original shims, O-ring, propeller shaft, bearing carrier, tabbed washer and retaining nut. Torque to 150 lb. ft. (203 N·m).



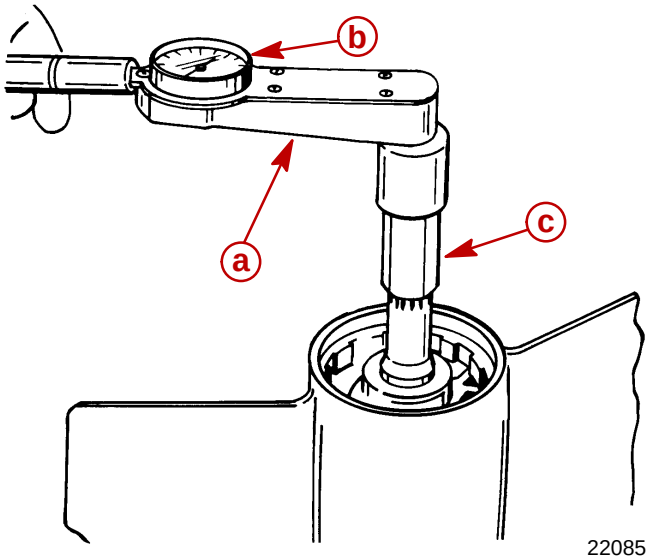
22111



22111

a - Washer
b - Original Shims
c - O-ring
d - Propeller Shaft
e - Bearing Carrier
f - Tabbed Washer
g - Retaining Nut

2. Check propeller shaft bearing preload.



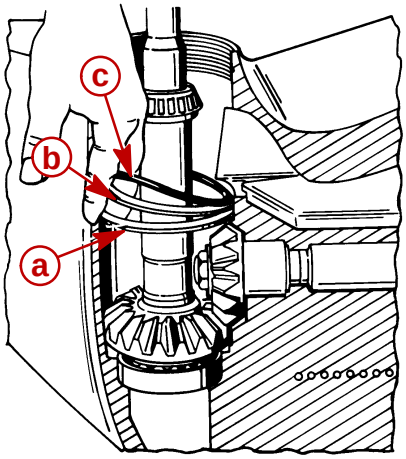
22085

a - Torque Wrench - Rotate
b - Dial Indicator - New Bearings 8-12 lb. in. (0.9-1.4 N·m) Used Bearings 5-8 lb. in. (0.6-0.9 N·m)
c - Adaptor - Propeller Shaft Nut Can Be Used

3. If dial indication is other than specified:

If dial indication is **lower** than specified: **Remove** shim(s) from in front of bearing carrier.

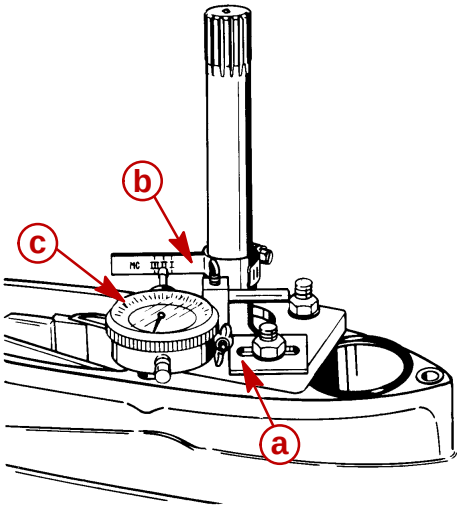
If dial indication is **higher** than specified: **Add** shim(s) in front of bearing carrier.



22111

a - Washer
b - Shims
c - O-ring
a - Tab Washer
b - Retaining Nut

4. Install the following special tools:
Dial Indicator Adaptor (P/N 91-83155),
Backlash Indicator Rod (P/N 91-53459), and
Dial Indicator (P/N 91-58222A1), as shown. Ensure dial rod is aligned with “II” on indicator rod.



22439

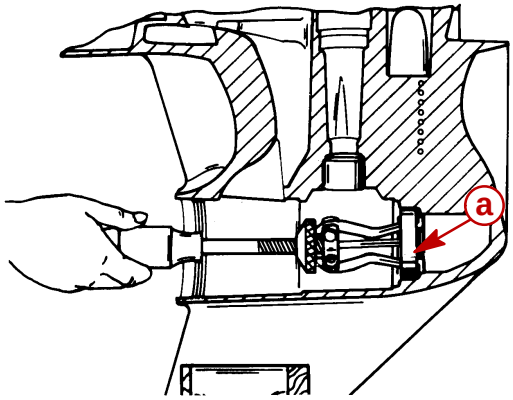
a - Dial Indicator Adapter
b - Backlash Indicator Rod
c - Dial Indicator

5. Check gear backlash by lightly rotating drive shaft back and forth. Do not allow propeller shaft to turn. Observe dial indicator and record the reading.

6. Check the backlash in four different positions by rotating the drive shaft 90° after taking each reading. Average the readings. The readings should average .012-.015 in. (0.28-0.38mm). Make sure all the readings are within the .012-.015 in. (0.28-0.38mm) range.

Index

7. If backlash is not correct, disassemble and proceed as follows:
   a. If backlash is **more** than specified: **Add** shim(s) under driven gear bearing cup.
   b. If backlash is **less** than specified: **Remove** shim(s) under driven gear bearing cup.

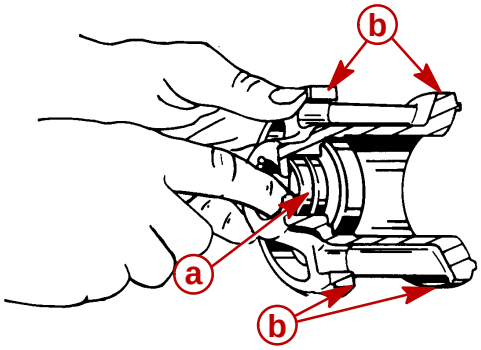


22083

a - Driven Gear Bearing Cup

IMPORTANT: Bearing carrier and threads on bearing carrier retaining nut must be lubricated to prevent corrosion and cracking in gear housing. Coat O.D. on carrier mating surfaces (b) with Perfect Seal.

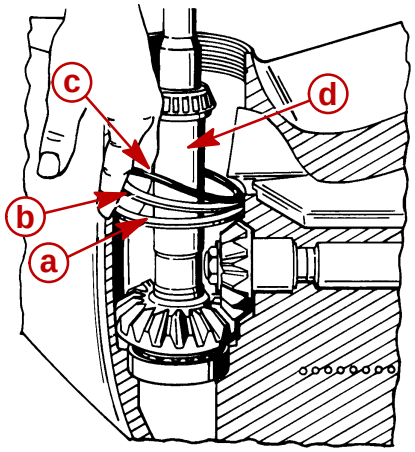
8. Lubricate bearing carrier. Fill space between seals with 2-4-C Marine Lubricant with Teflon and coat mating surfaces with Perfect Seal.



22111

a - Space Between Seals
b - Mating Surfaces

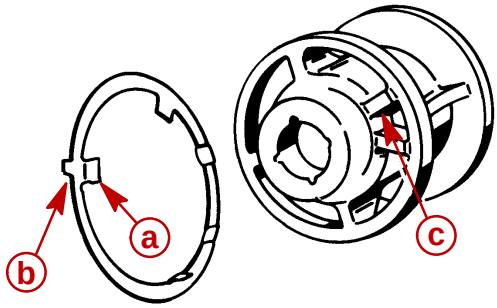
9. Install washer, shims, O-ring and propeller shaft.



22111

a - Washer
b - Original Shims
c - O-ring
d - Propeller Shaft

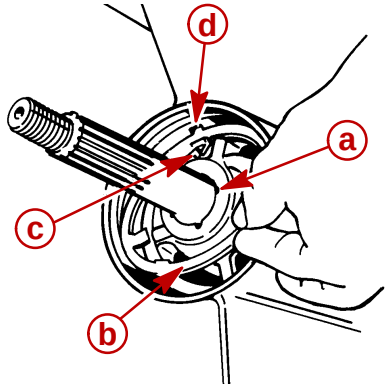
IMPORTANT: The bearing carrier is kept from spinning in gear case by the tab washer. Be sure that the inner tab is positioned in the "V" notch in bearing carrier and outer tab fits into hole in gear case bore.



23257

a - Inner Tab - Position in V-notch of Carrier
b - Outer Tab
c - "V"-Notch

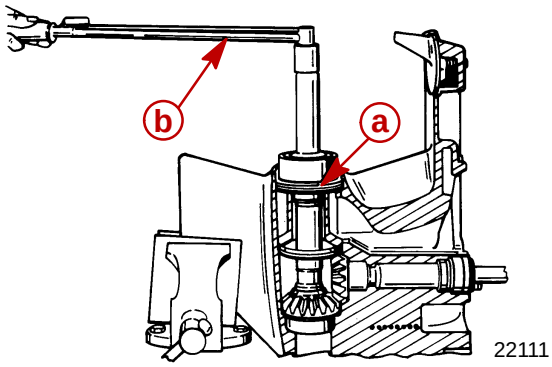
10. Install bearing carrier and tab washer in gear housing. Position inner tab in V-notch.



23257

a - Bearing Carrier
b - Tab Washer
c - Inner Tab
d - Outer Tab

11. Lubricate threads on bearing carrier retainer with Special Lubricant 101; then install retaining nut and torque to 150 lb. ft. (203 N·m).

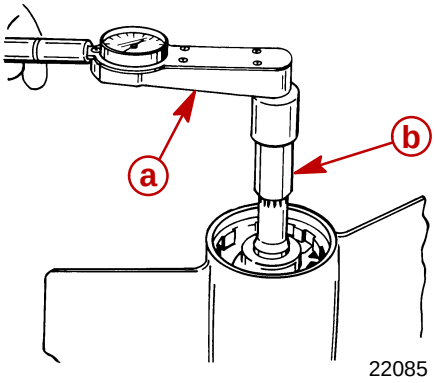


a - Bearing Carrier Retainer Nut
b - Lb. ft. Torque Wrench

12. Recheck backlash from preceding steps at this time. Remove dial indicator if correct. **DO NOT remove clamp plate.**

IMPORTANT: A bearing is considered used if spun under load once.

13. Check propeller shaft bearing preload. New bearings should be 8-12 lb. in. (0.9-1.4 N·m). used bearings should be 5-8 lb. in. (0.6-0.9 N·m).

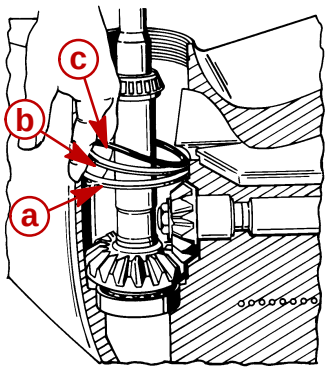


a - Torque Wrench - Rotate
b - Adaptor - Propeller Shaft Nut Can Be Used

14. If dial indication is other than specified:

If dial indication is **lower** than specified: **Remove** shim(s) from in front of bearing carrier.

If dial indication is **higher** than specified: **Add** shim(s) in front of bearing carrier.



a - Washer
b - Shims
c - O-ring
a - Tab Washer
b - Retaining Nut

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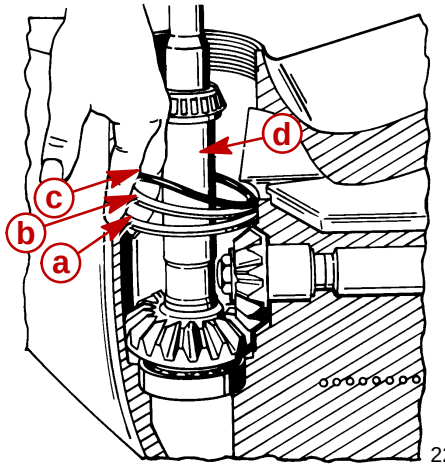
Driven Gear Shimming for Models With Load Ring

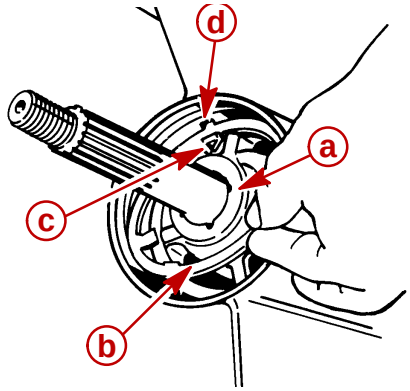
1. Install the load ring, thrust ring, and o-ring into the gear housing.



22111

a - Load Ring (0.105)
b - Thrust Ring (.105 Thickness)
c - O-ring
d - Propeller Shaft

2. Install the later style bearing carrier (41641A8) and tab washer in the gear housing.



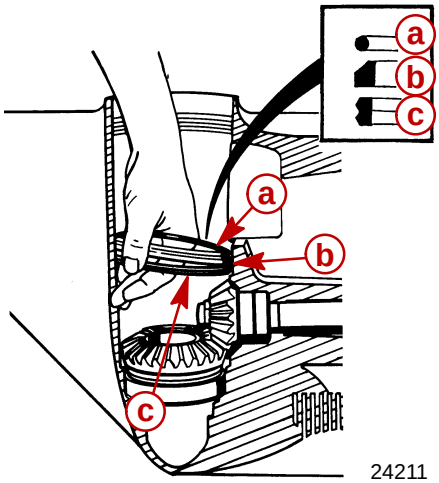
23257

a - Bearing Carrier
b - Tab Washer
c - Inner Tab - Position in V-notch
d - Outer Tab

3. Lubricate threads on bearing carrier retaining nut with Special Lubricant 101. Install and tighten bearing carrier retainer until resistance to propeller shaft rotation can be felt.

4. Install and tighten bearing carrier retaining nut until no more end-play can be felt. **DO NOT TORQUE.**

IMPORTANT: Always use a new load ring when reassembling and for final assembly.

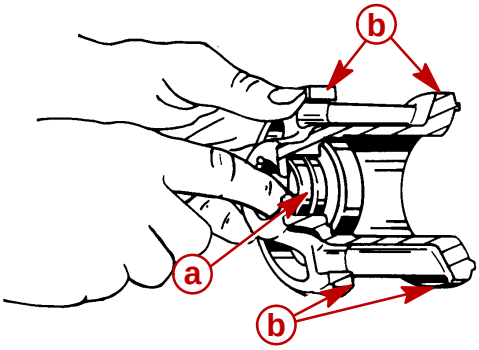


24211

a - O-ring
b - Thrust Ring
c - Load Ring

IMPORTANT: Bearing carrier and threads on retainer must be lubricated to prevent corrosion and cracking in gear housing. Use Special Lubricant 101 on retainer; coat O.D. on carrier "rounds" with Perfect Seal.

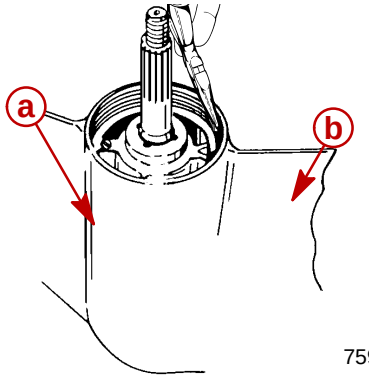
5. Lubricate bearing carrier seals. Fill space between seals with 2-4-C Marine Lubricant with Teflon and coat carrier mating surfaces with Perfect Seal.



22111

a - Space Between Seals
b - Mating Surfaces

6. Install bearing carrier and locating key in gear housing.



75925

a - Bearing Carrier
b - Locating Key

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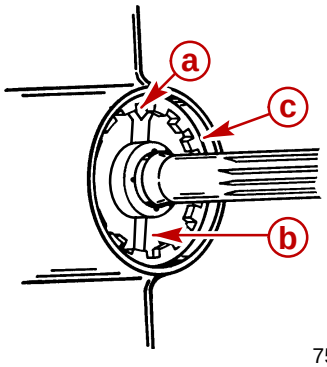
7. Install tab washer with V-notch positioned as shown in recess in carrier.



75923

a - Tab Washer - “V” Notch in Recess in Carrier
b - Bearing Carrier
c - Bearing Carrier Retainer

8. Lubricate threads on bearing carrier retaining nut with Special Lubricant 101. Install, and tighten bearing carrier retainer until resistance to propeller shaft rotation can be felt (to preload bearings).

9. Tighten the retainer to the proper overall preload. To determine overall gear case preload add bearing preload to drive shaft preload as outlined in the example below.

IMPORTANT: The overall preload includes both the drive shaft preload and the gear case preload.

Preloads	
New Bearings	8-12 lb. in. (.9-1.4 N·m)**
Used Bearings*	5-8 lb. in. (.6-.9 N·m)**
Drive Shaft	3-5 lb. in. (.3-.6. N·m)

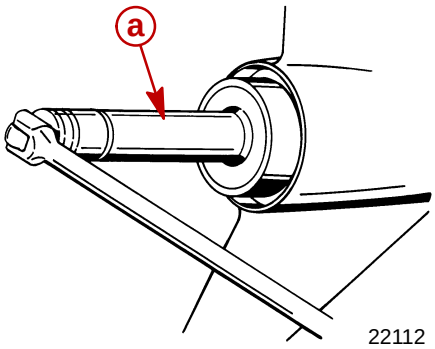
* Bearing is considered used if spun under load even once (“under load” meaning: “with power applied”).

**Plus drive shaft preload [3-5 lb. in. (.3-.6 N·m)]

Example:

Drive Shaft Preload 3 lb. in. (.3 N·m)
+
New Bearing Preload 8 lb. in. (.9 N·m)
11 lb. in. (1.2 N·m)

10. Tighten the retainer to the proper preload using the following procedure.
    a. Tighten the retainer in small increments.

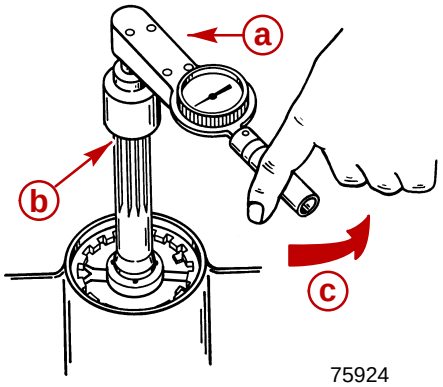


22112

a - Bearing Carrier Retainer Wrench (91-17257)

Index

b. After tightening, check overall gear housing bearing preload at propeller shaft. Rotate shaft in direction of normal rotation in a smooth, steady motion.

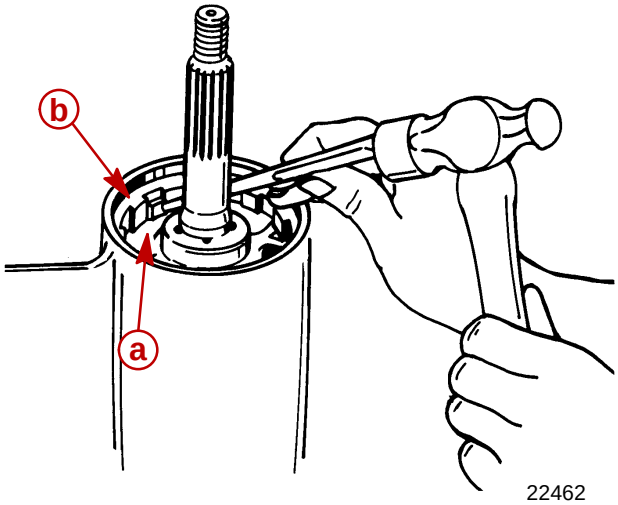


75924

a - Lb. in. Torque Wrench 91-66274
b - Propeller Nut (under socket)
c - Shaft Rotation Direction

ALL MODELS

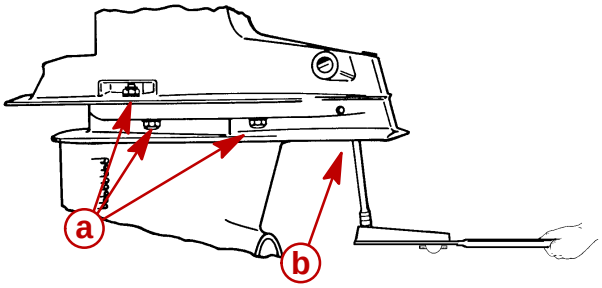
11. Bend one tab into retaining nut as shown after propeller shaft preload has been set correctly. Bend remaining tabs down into gear housing.



22462

a - Tab Washer
b - Retaining Nut

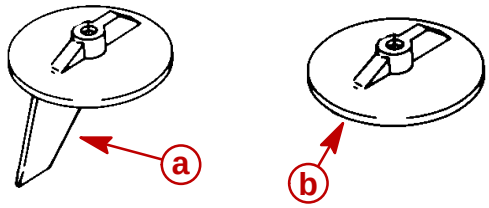
12. Install gear housing to drive shaft housing. Torque all fasteners to 35 lb. ft. (47 N·m).



73927

a - 6 Nuts and Washers (3 Each Side)
b - 1 Bolt (Located in Trim Tab Cavity)

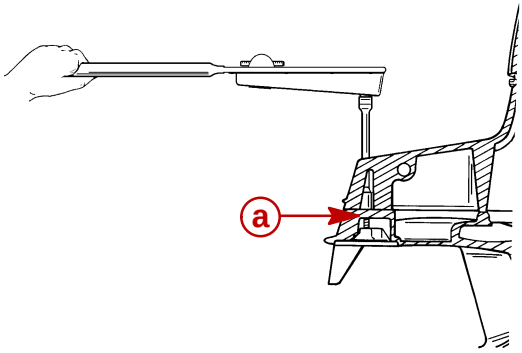
NOTE: *Later model Bravo One drive units are equipped with an anodic plate instead of trim tab. Replacement procedure is the same.*



75251

a - Trim Tab
b - Anodic Plate

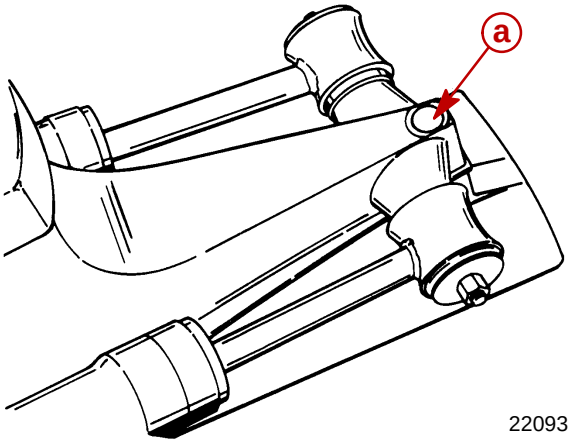
13. Install trim tab or anodic plate. Torque bolt to 23 lb. ft. (32 N·m).



73926

a - Bolt

14. Install plastic plug.



22093

a - Plastic Plug

15. Reinstall drive unit. Refer to Section 2A.

16. Fill drive unit with gear lube. Refer to Section1B.

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STERNDRIVE UNIT

Section 3C - Bravo Two Gear Housing

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3 C

Specifications

Torque Specifications

DESCRIPTION	TORQUE		
	lb. in.	lb. ft.	N·m
Pinion Nut		100	136
Drive Shaft Housing to Gear Housing Nuts and Bolt		35	48
Trim Tab or Anodic Plate Screw		20	27
Oil Fill/Drain Plug	20-30		3.4-5.6

Preloads

DESCRIPTION	TORQUE	
	lb. in.	N·m
Driveshaft Bearings	3-5	0.3-0.8
Propeller Shaft Bearings - Checked at Propeller Shaft (New Bearings)	8-12*	0.9-1.4*
Propeller Shaft Bearings - Checked at Propeller Shaft (Used Bearings)**	5-8*	0.6-0.9*

* DOES NOT include 3 to 5 lb. in. (0.3-0.6 N·m) on driveshaft.
** A bearing is used if spun once under load.

Lubricants/Sealers/Adhesives

DESCRIPTION	PART NUMBER
Quicksilver High-Performance Gear Lube	92-816026A4
Quicksilver 2-4-C Marine Lubricant with Teflon	92-825407A12
Quicksilver Special Lubricant 101	92-13872A1
Quicksilver Needle Bearing Assembly Lubricant	92-825265A1
Perfect Seal	92-34227-2
3-M Adhesive	92-86166-1
Loctite Type 27131	92-809820
Quicksilver Engine Coupler Spline Grease	92-816391A4

Special Tools

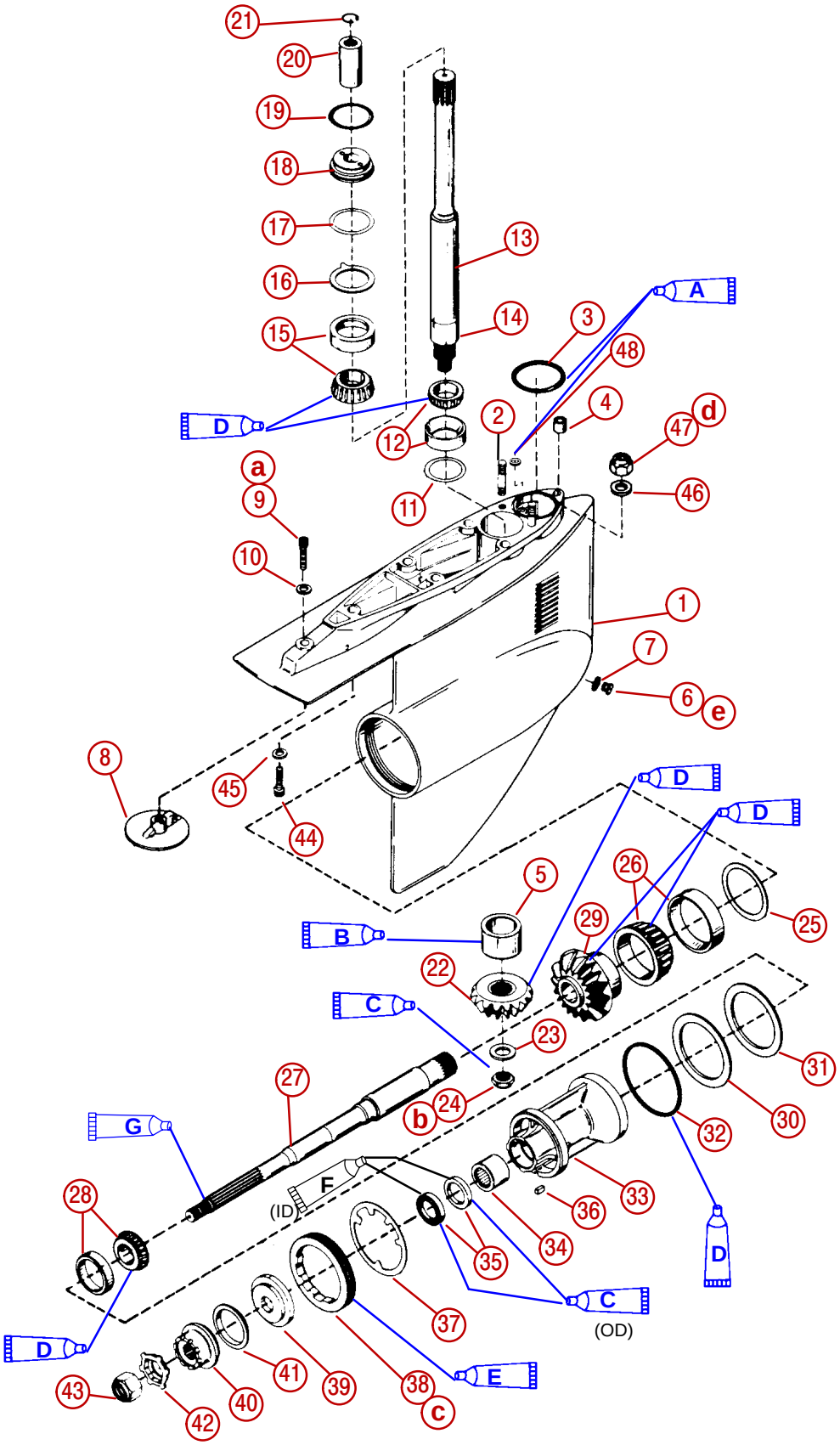
DESCRIPTION	PART NUMBER
Universal Puller Plate	91-37241
Bearing / Seal Driver	91-89868
Bearing Driver	91-89867
Threaded Rod	91-31229
Bearing Cup Driver	91-67443
Driver Rod	91-37323
Bearing Removal Tool	91-63638
Drive Shaft Adaptor Tool	91-56775
Bearing Driver	91-55919
Bearing Cup Driver	91-63626
Bearing Driver	91-55918
Oil Seal Driver	91-55916
Bearing Driver	91-68891
Seal / Bearing Driver	91-63619

Gear Ratio - Teeth per Gear (Gear Housing)

RATIO	DRIVE	DRIVEN
2.20:1	16	27
2.00:1	16	27
1.81:1	16	27
1.65:1	18	25
1.50:1	18	25

Bravo Two Gear Housing Exploded View

Drive Shaft and Propeller Shaft Components



Index

1 - Gear Housing
2 - Stud
3 - O-ring
4 - Seal
5 - Roller Bearing
6 - Fill/Drain Screw
7 - O-ring
8 - Anodic Plate
9 - Screw
10- Washer
11- Shim
12- Tapered Roller Bearing
13- Drive Shaft
14- Bearing Race
15- Tapered Roller Bearing
16- Tab Washer
17- Shim Assembly
18- Spacer
19- O-ring
20- Coupling
21- Retaining Ring
22- Pinion Gear
23- Washer
24- Nut
25- Shim Assembly
26- Tapered Roller Bearing
27- Propeller Shaft
28- Tapered Roller Bearing
29- Drive Gear
30- Trust
31- Load Ring
32- O-ring
33- Bearing Carrier
34- Roller Bearing
35- Oil Seal
36- Locating Key
37- Tab Washer
38- Bearing Carrier Retainer
39- Thrust Hub
40- Washer Assembly
41- Thrust Washer
42- Tab Washer
43- Propeller Nut
44- Screw
45- Lockwasher
46- Washer
47- Nut
48- Quad Ring

Lubricants, Sealers, and Adhesives

- 3M Brand Adhesive 92-86166-1

- Quicksilver Needle Bearing Assembly Lubricant 92-825265A1

- Loctite 27131 92-809820

- Quicksilver High Performance Gear Lube (Use on All Bearing Surfaces) 92-816026A4

- Quicksilver Special Lubricant 101 . . . . . 92-13872A1

- Quicksilver 2-4-C Marine Lubricant with Teflon 92-825407A12

- Quicksilver Engine Coupler Spline Grease 92-816319A4

Torque Specifications

a - 23 lb. ft. (32 N·m)
b - 125 lb. ft. (169 N·m)
c - Tighten to Proper Gear Case Preload
d - 35 lb. ft. (48 N·m)
e - 30-50 lb. in. (3.4-5.6 N·m)

Gear Ratio - Teeth per Gear (Gear Housing)

RATIO	DRIVE	DRIVEN
2.20:1	16	27
2.00:1	16	27
1.81:1	16	27
1.65:1	18	25
1.50:1	18	25

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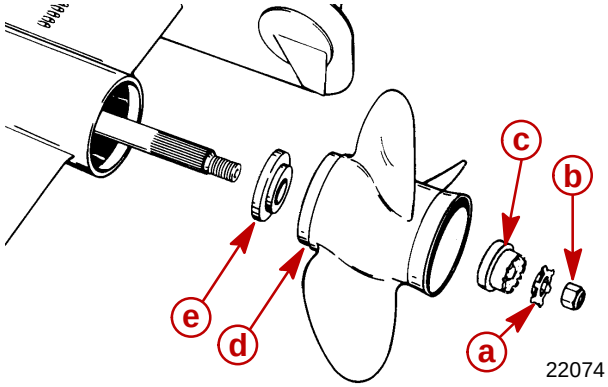
Pre-Disassembly Inspection

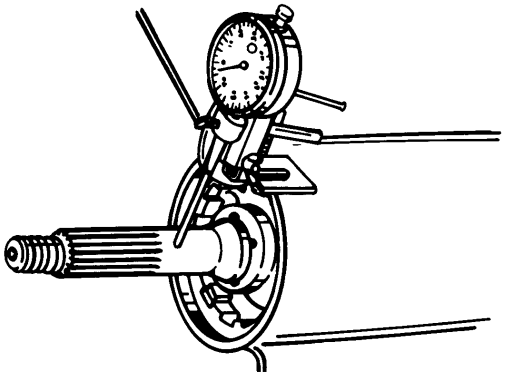
1. Bend tabs straight on tab washer. Remove nut, washer, spline washer, propeller and thrust hub.



a - Tab Washer
b - Nut
c - Spline Washer
d - Propeller
e - Thrust Hub

2. Check propeller shaft for side to side movement, as follows:
   a. Position dial indicator on propeller shaft.
   b. Push propeller shaft to one side and zero the dial indicator.
   c. Move propeller shaft to opposite side while observing dial indicator. Without rotating propeller shaft, reposition dial indicator and check up and down deflection. A shaft deflection of more than .003 in. (0.08mm) indicates one of the following:

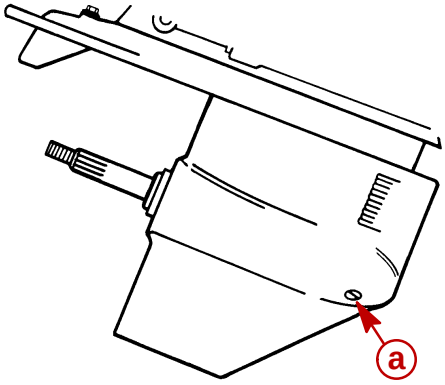
- Worn propeller shaft bearings
- Improper propeller shaft preload.



3. Check for a bent propeller shaft, as follows:
   a. Rotate propeller shaft while observing dial indicator. If deflection is more than .005 in. (.127mm), a bent propeller shaft is indicated.

Drive Shaft Housing and Gear Housing Separation

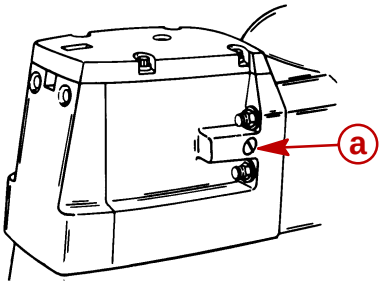
1. **Models with Gear Lube Monitor:** remove, empty and clean monitor. Lubricate neck O-ring seal with gear lube before replacing cap.
2. Tilt drive unit to a 45 degree angle. Remove fill/drain screw and drive shaft housing vent screw or dipstick. Allow drive unit to drain completely.



50323

a - Fill/Drain Screw

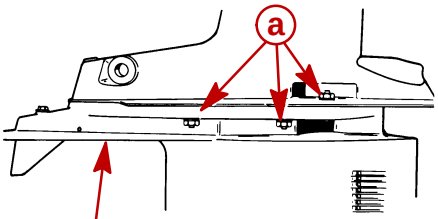
3. Remove vent screw.



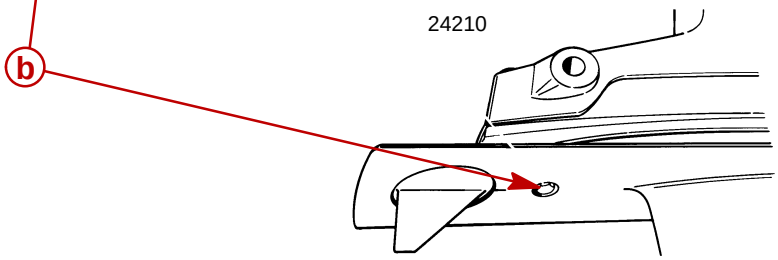
50072

a - Vent Screw

4. Remove gear housing from drive shaft housing.



24210



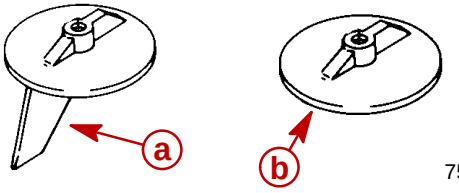
24211

a - 6 Nuts and Washers – Remove
b - 1 Bolt

5. Finish draining gear case by turning upside down over container.

Gear Housing Disassembly

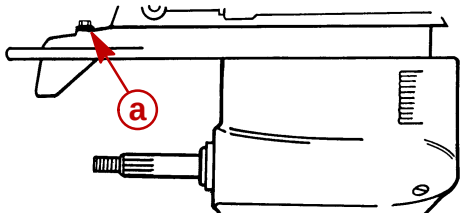
NOTE: *Later model Bravo Two drive units are equipped with an anodic plate instead of trim tab. Replacement procedure is the same.*



75251

a - Trim Tab
b - Anodic Plate

1. Remove bolt and trim tab or anodic plate.



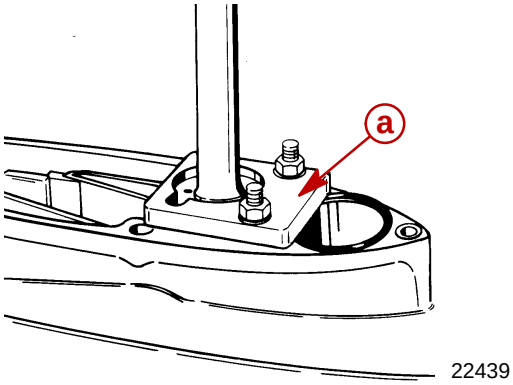
50323

a - Bolt

⚠ CAUTION

Clamp plate (91-43559) must be installed on gear housing when gear housing is separated from drive shaft housing.

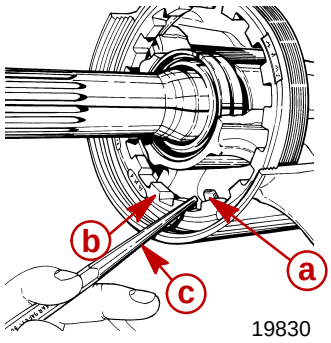
2. Install clamp plate on gear housing. Tighten securely.



22439

a - Clamp Plate

3. Bend tabs of tab washer away from bearing carrier retainer.



19830

a - Tab Washer
b - Bearing Carrier Retainer
c - Punch

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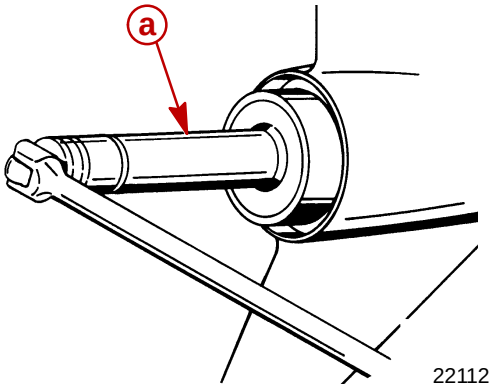
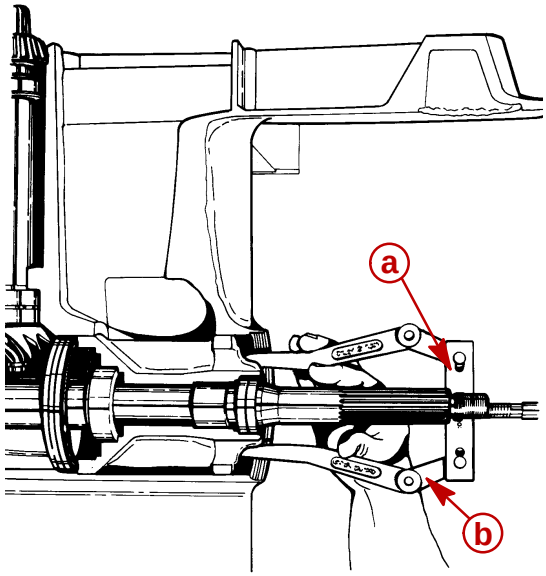
4. Remove bearing carrier retainer using bearing carrier retainer wrench.

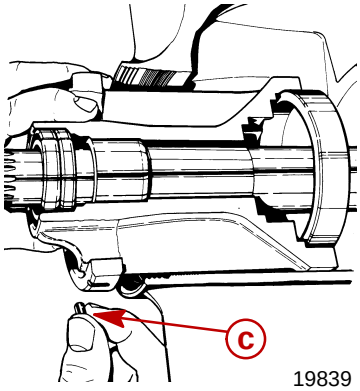


a - Bearing Carrier Retainer Wrench (91-17257)

5. Remove bearing carrier. Be careful not to lose locating key.

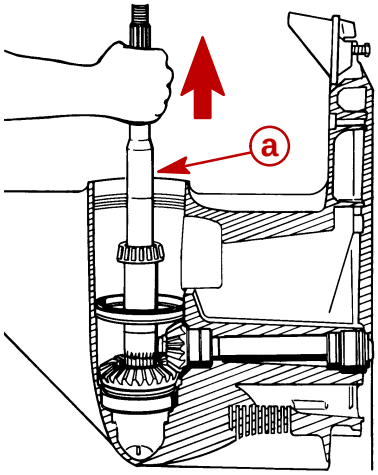


a - Slide Hammer Puller, 91-34569A1
b - Puller Jaws, 91-46086A1



c - Locating Key

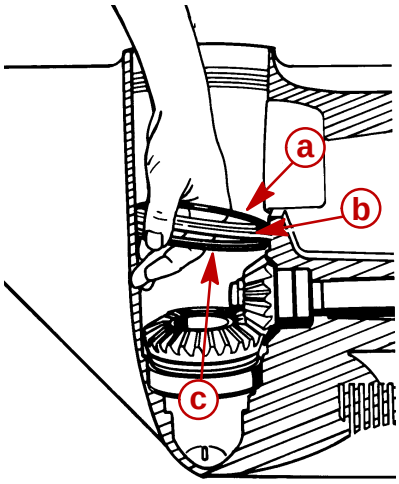
6. Remove propeller shaft assembly.



24211

a - Lift Propeller Shaft from Gear Housing

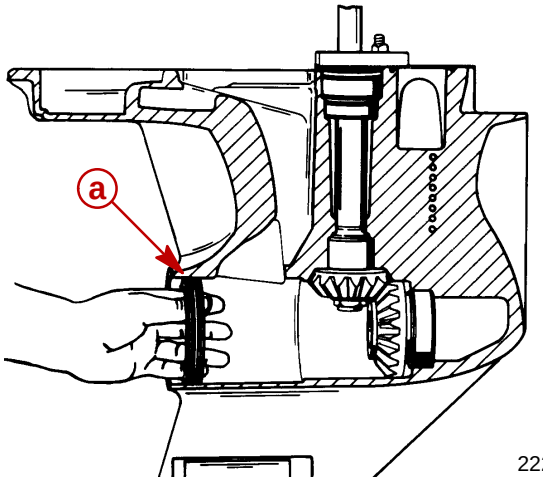
7. Remove items shown.



24211

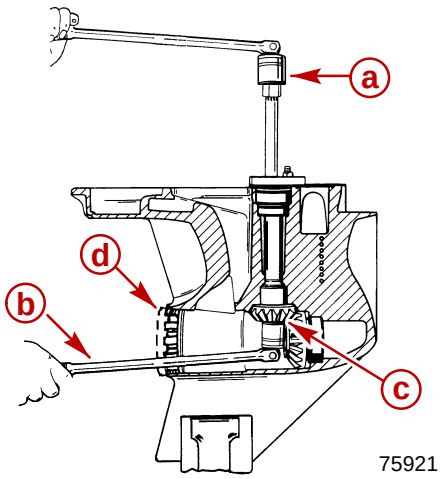
a - O-ring
b - Thrust Ring
c - Load Ring

8. By hand, temporarily reinstall retaining ring nut in gear housing to protect housing threads. Remove pinion gear, nut and washer.



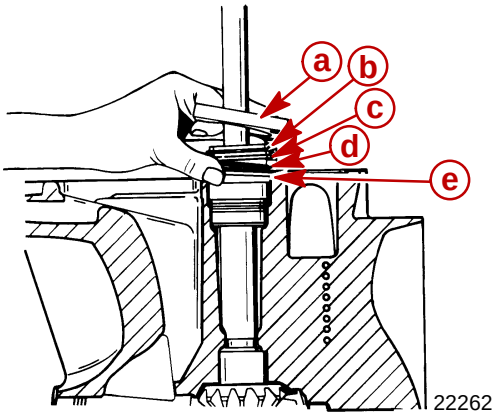
22217

a - Retaining Ring Nut



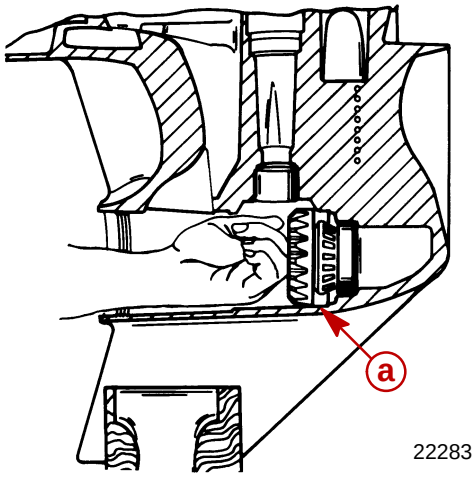
a - Drive Shaft Adaptor Tool (91-61077)
b - Breaker Bar and Socket
c - Pinion Gear
d - Bearing Carrier Retainer

9. Remove clamp plate (installed in Step 2), then remove O-ring, spacer, shim(s) and tab washer.



a - Drive Shaft – Pull Up
b - Pinion Gear
c - Spacer
d - Shim(s)
e - Tab Washer

10. Remove driven gear and bearing.



a - Driven Gear and Bearing

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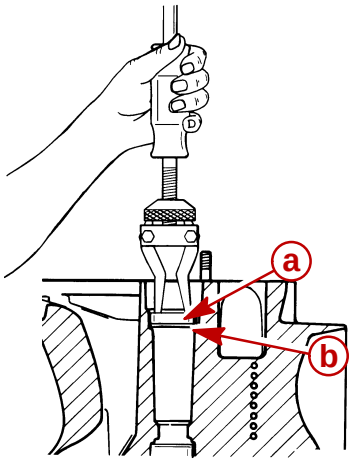
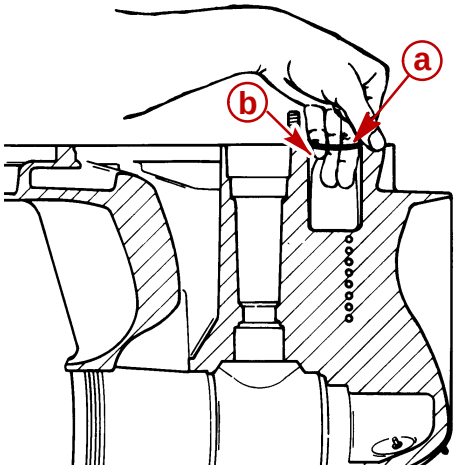
11. Remove drive shaft bearing cup and shims.



22261

a - Drive Shaft Bearing Cup
b - Shims

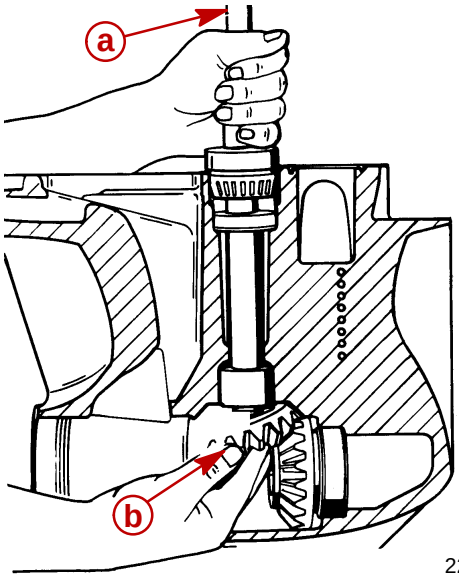
12. Remove water passage O-ring and oil passage quad ring.



22222

a - Remote Water Passage O-ring
b - Oil Passage Quad Ring

13. Remove drive shaft and pinion gear.



22259

a - Drive Shaft
b - Pinion Gear

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Component Servicing

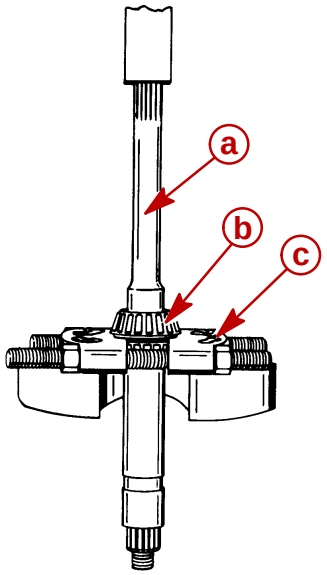
Drive Shaft and Pinion Bearing Inspection and Cleaning

1. The condition of the drive shaft tapered bearing cups is an indication of the condition of the tapered roller bearings on the drive shaft. Replace bearing and bearing cup if cup is pitted, grooved, scored, worn uneven, discolored from overheating, or has embedded metal particles.
2. The condition of the bearing surface on drive shaft at needle bearing location is an indication of the condition of needle bearings. Replace needles and sleeve if pitted, grooved, scored, worn uneven, discolored from overheating, or has embedded metal particles.
3. Inspect splines for worn or twisted condition. Replace drive shaft if either condition exists.
4. Clean all parts that are to be reused with solvent. Dry parts completely using compressed air, being careful not to spin bearings.

Drive Shaft Disassembly

NOTE: *Bearing assembly must be replaced if removed from drive shaft. Tapered roller bearings are damaged when removing.*

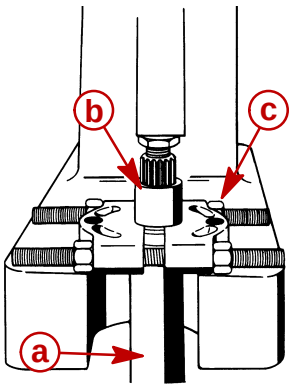
1. Press tapered roller bearing from shaft using universal puller plate (91-37241) to support bearing on bearing inner race. Remove second tapered roller bearing in same manner.



22109

a - Drive Shaft
b - Bearing
c - Universal Puller Plate

2. Press drive shaft pinion bearing inner race from drive shaft, using universal puller plate.



24210

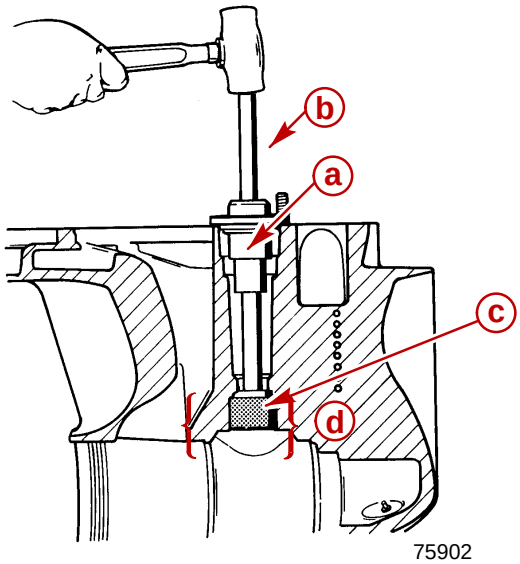
a - Drive Shaft
b - Pinion Bearing Inner Race
c - Universal Puller Plate (91-37241)

Pinion Bearing Removal

NOTE: *Both earlier and later model pinion bearings can be removed with the pinion bearing driver specified in the next step.*

IMPORTANT: All needle bearings MUST BE in place inside bearing casing while driving pinion bearing from gear case or bearing casing will bend or break and become difficult to remove.

1. Heat area around bearing remover to approximately 200° F (93.3°C) to ease removal. Do not use open flame. Remove pinion bearing. Check that tabs on bearing remover align with slots in gear housing bore.



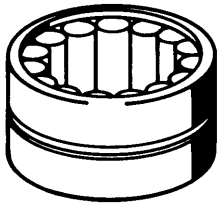
75902

a - Bearing Driver (91-89868) – Used as Pilot
b - Driver Rod (91-37323)
c - Bearing Remover (91-63638)
d - Area Around Bearing Remover

Pinion Bearing Installation

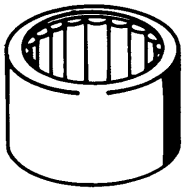
PINION BEARING

Earlier Style



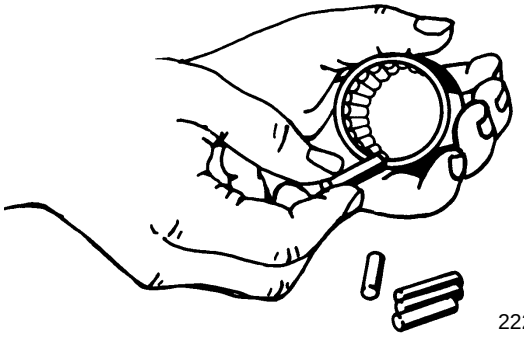
Use with gear housing casting number 1641-8293C

Later Style



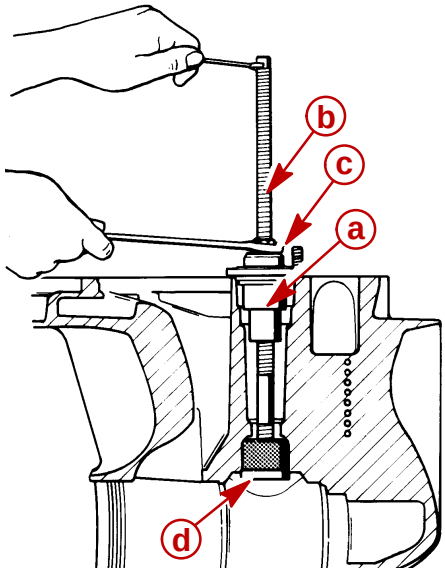
Use with gear housing casting number 1641-8293C1

1. **On models with later style pinion bearing:** ensure all needle bearings are in place. Use needle bearing assembly lubricant to help hold needle bearings in casing.



22219

2. Install pinion bearing using tools as shown. Use the bearing driver as a pilot.

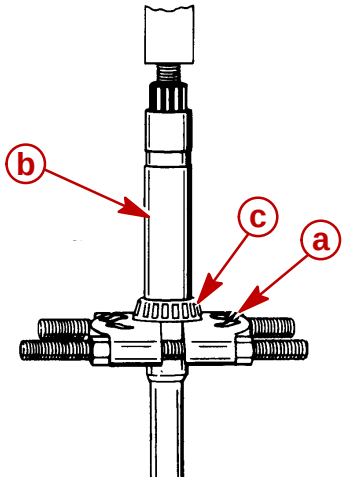


22222

a - Bearing Driver (91-89868)
b - Puller Shaft (91-31229)
c - Washer and Nut
d - Driver (91-89867)

Drive Shaft Reassembly

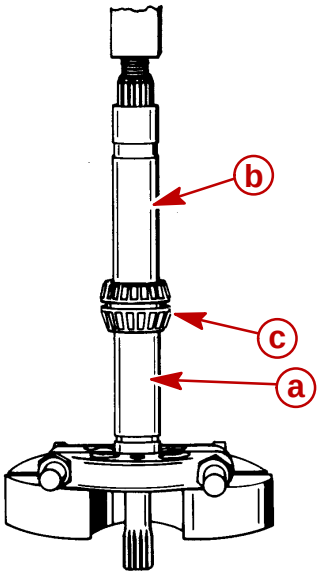
1. Lubricate I.D. of tapered roller bearing with gear lube. Press small tapered roller bearing onto drive shaft. Ensure smaller O.D. faces pinion end of shaft.



22109

a - Universal Puller Plate
b - Drive Shaft
c - Small Tapered Roller Bearing

2. Lubricate I.D. of tapered roller bearing with gear lube. Press large tapered roller bearing onto drive shaft. Ensure larger O.D. faces pinion end of shaft.



22109

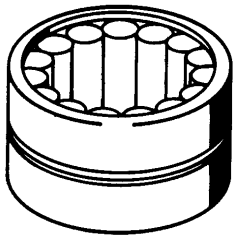
a - Suitable Mandrel – Support on Inner Bearing Race
b - Drive Shaft
c - Large Tapered Roller Bearing

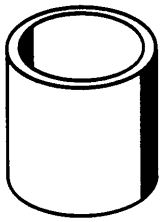
IMPORTANT: The drive shaft pinion bearing inner-race on an earlier drive unit has a slightly larger O.D. (1.473 in.); a later drive unit bearing inner-race has a slightly smaller O.D. (1.467 in.).

⚠ CAUTION

The specific pinion bearing, inner-race, and drive shaft, to be used – if replaced – must be determined by the gear housing casting number. An improper bearing race will cause premature pinion bearing failure, and damage to drive unit.

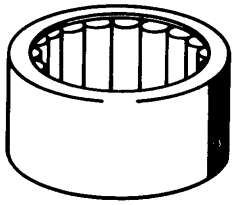
Earlier Style

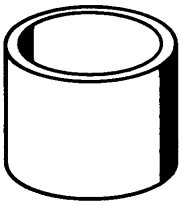




Use with Gear Housing Casting Number 1641-8293C

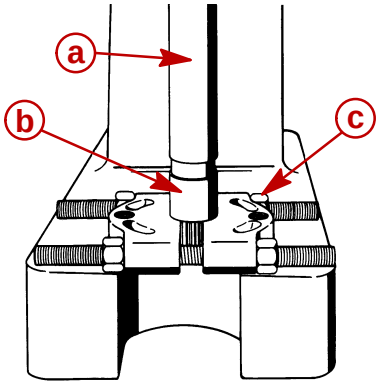
Later Style





Use with Gear Housing Casting Number 1641-8293C1

3. Press drive shaft pinion bearing inner-race onto drive shaft until race is fully seated, using universal puller plate.



24210

a - Drive Shaft
b - Pinion Bearing Inner-Race
c - Universal Puller Plate (91-37241)

Bearing Carrier Inspection

1. The condition of the propeller shaft tapered roller bearing cup is an indication of the condition of tapered roller bearing on propeller shaft. Replace bearing and cup if cup is pitted, grooved, scored, worn, uneven, discolored from overheating, or has embedded metal particles.
2. Check bearing carrier for signs of corrosion, especially on gear housing to bearing carrier mating surfaces. If corrosion is evident, replace bearing carrier.

Bearing Carrier Servicing

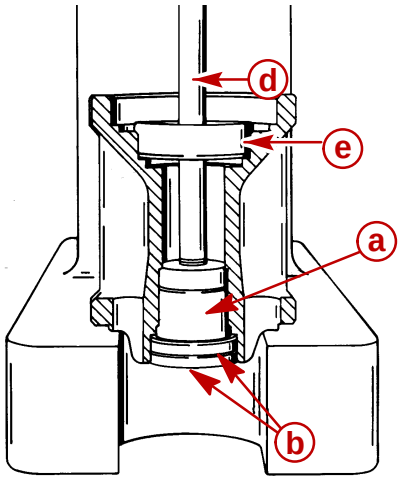
DISASSEMBLY

1. Perform Method “A” or “B,” following:

Method “A” – If Replacing Propeller Shaft Needle Bearing

a. Press needle bearing and oil seals from carrier.

NOTE: *Needle bearing MUST BE replaced, if removed.*

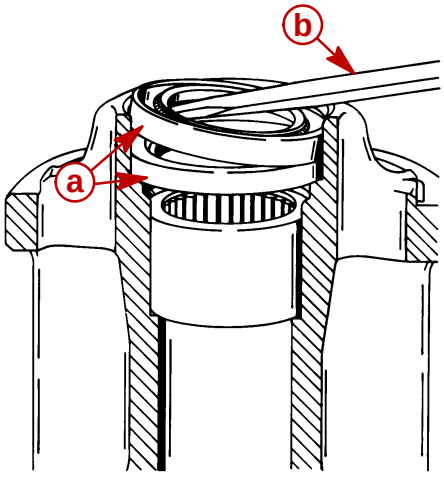


50023

a - Needle Bearing
b - Oil Seals (2)
c - Driver - 91-55919
d - Driver Rod
e - Bearing Cup

Method “B” – If Propeller Shaft Needle Bearing Replacement is NOT Required

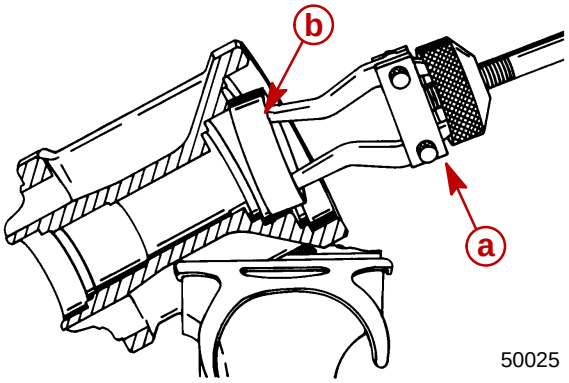
b. Pry oil seals from carrier.



50024

a - Oil Seals (2)
b - Pry Bar or Screwdriver

2. Remove bearing cup.

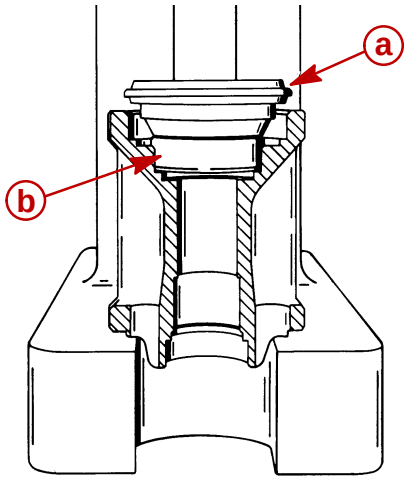


50025

a - Slide Hammer Puller, 91-34569A1
b - Bearing Cup

REASSEMBLY

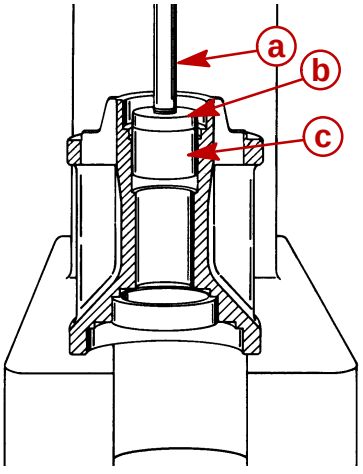
1. Install bearing cup.



50023

a - Driver - 91-63626
b - Bearing Cup

2. Install needle bearing.



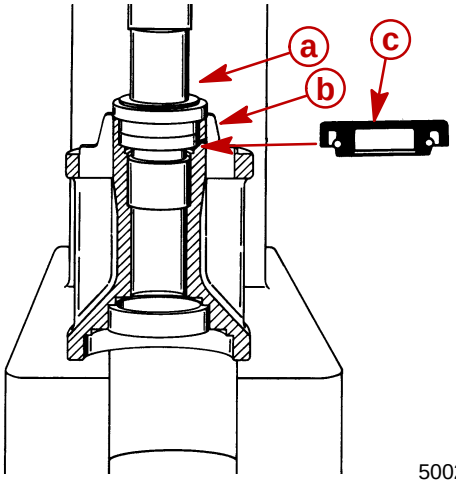
50025

a - Driver Rod - *91-37323
b - Driver - 91-55918
c - Needle Bearing

* Contained in Bearing Removal and Installation Tool Kit, 91-31229A5.

Index

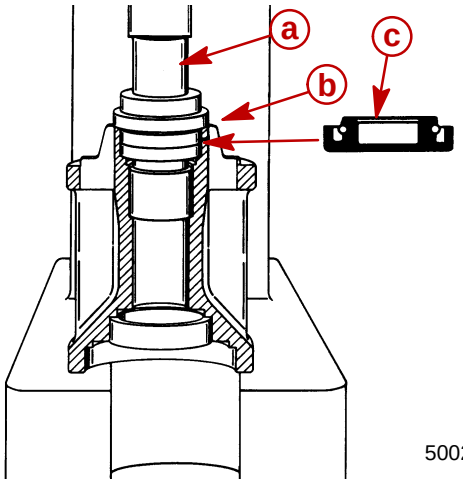
3. Coat O.D. of oil seal with Loctite Type “A” or 27131. Install inner oil seal with lip facing inward.



50024

a - Driver - 91-55916
b - Wide Shouldered End
c - Inner Oil Seal

4. Coat O.D. of oil seal with Loctite Type “A” or 27131. Install outer oil seal with lip facing outward.



50025

a - Driver - 91-55916
b - Narrow Shouldered End
c - Outer Oil Seal

5. Fill area between seals with 2-4-C Marine Lubricant with Teflon.

Propeller Shaft Inspection

1. Check propeller shaft for bent condition. Use either method “a or b” following:
   a. **Lathe And Dial Indicator Method:**
      (1.) Position propeller shaft centers in lathe.
      (2.) Mount dial indicator at front edge of propeller shaft.
      (3.) Rotate shaft and observe dial indicator. Movement of more than .005 in. (.127mm) is reason for replacement.

b. **V-blocks And Dial Indicator Method:**

(1.) Position propeller shaft bearing surfaces on V-blocks.

(2.) Mount a dial indicator at front edge of propeller shaft.

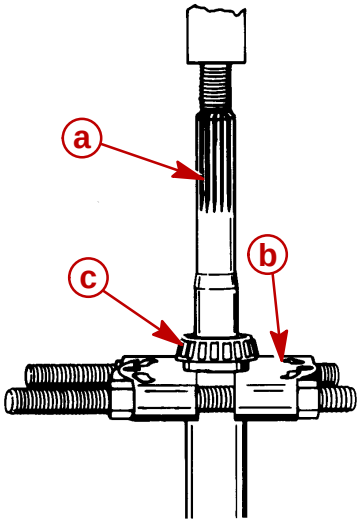
(3.) Rotate shaft and observe dial indicator. Movement of more than .005 in. (.127mm) is reason for replacement.

2. Inspect for bent or twisted splines.

3. Inspect surface of shaft where bearing carrier oil seal lips contact shaft. Oil seals will have to be replaced if any grooves are found.

Propeller Shaft Bearing Removal

1. Press bearing from propeller shaft.

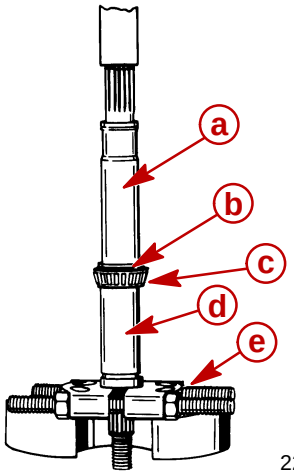


22110

a - Propeller Shaft
b - Universal Puller Plate (91-37241)
c - Tapered Roller Bearing

Propeller Shaft Bearing Installation

1. Install washer on shaft. Apply Gear Lube to I.D. of new bearing. Install bearing to shaft using universal puller plate and a suitable mandrel (old bearing race) which supports bearing on inner race. Press into place.

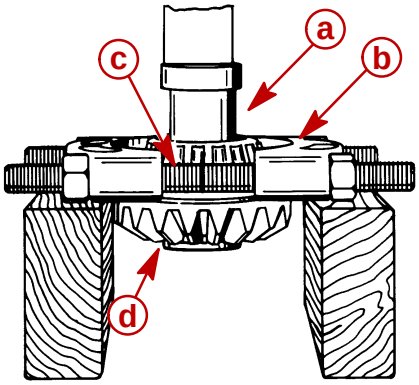


22110

a - Propeller Shaft
b - Inner Race (Against Step on Prop Shaft)
c - Tapered Roller Bearing
d - Suitable Mandrel
e - Universal Puller Plate (91-37241)

Driven Gear Bearing Removal and Inspection

1. Remove bearing from driven gear. Inspect both the driven gear and the pinion gear for pitting, chipped or broken teeth and excessive or uneven wear. Replace both gears if any of these conditions exist.

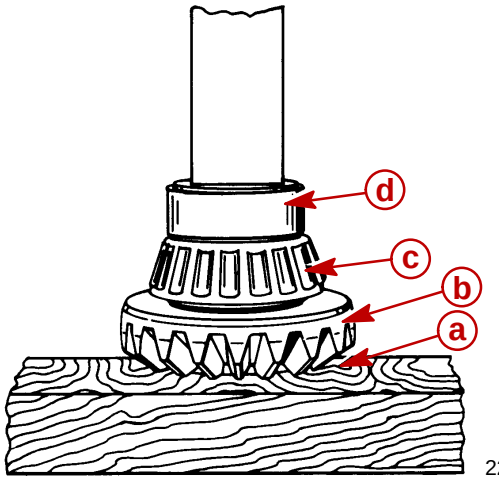


22108

a - Suitable Mandrel
b - Universal Puller Plate
c - Bearing
d - Driven Gear

Driven Gear Bearing Installation

1. Apply Gear Lube to I.D. of new bearing. Place a suitable mandrel (old bearing race) against new bearing race. Place another mandrel on face of gear and press gear and bearing together.

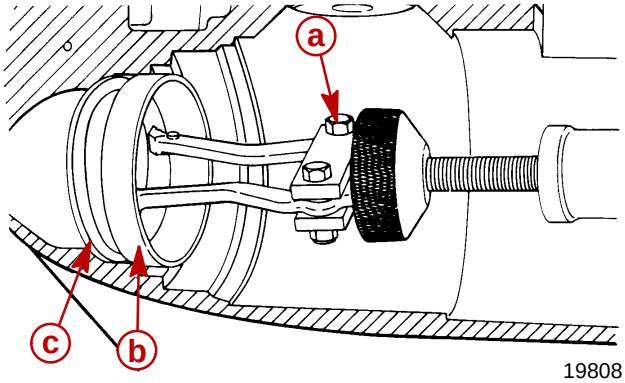


22108

a - Hard Wood or Metal Block
b - Driven Gear
c - Tapered Roller Bearing
d - Mandrel – Contacting Inner Race

Driven Gear Bearing Cup Removal and Inspection

1. Remove bearing cup and shims. Replace tapered roller bearing and cup if cup is pitted, grooved, scored, worn uneven, discolored from overheating, or has metal particles embedded in the cup.

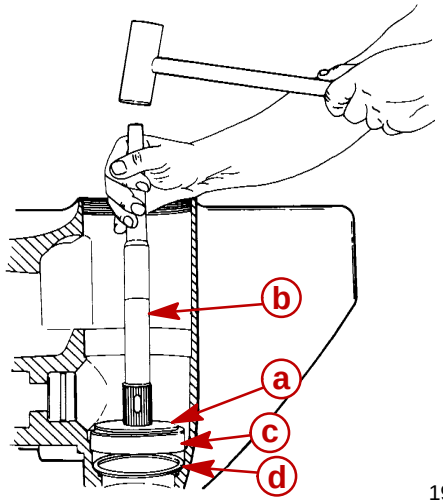


19808

a - Slide Hammer Puller, 91-34569A1
b - Bearing Cup
c - Shims

Driven Gear Bearing Cup Installation

1. Install driven gear bearing cup with original thickness shim(s). Ensure cup is not canted. Coat cup O.D. with Gear Lube.



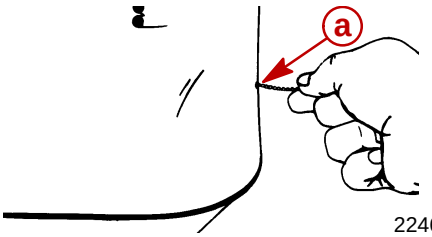
19917

a - Driver - 91-63626
b - Old MC-I Propeller Shaft
c - Bearing Cup
d - Shim(s)

NOTE: *If a MC-I propeller shaft is not available, use Driver Rod 91-37323 (from Bearing Removal and Installation Kit, 91-31229A7).*

Speedometer Water Tube Pickup Inspection and Cleaning

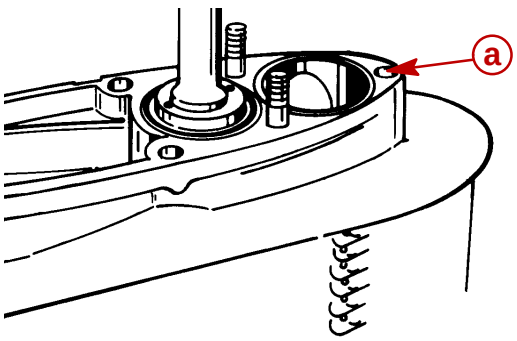
1. Inspect pitot tube on leading edge of gear housing for obstruction. Clean opening with a short piece of wire, if necessary. If obstruction can not be removed with wire, carefully re-open tube using a 5/64 in. (2mm) diameter drill bit. Do not drill beyond a depth of 2-7/16 in. (62mm).



22462

a - Pitot Tube

2. Inspect water tube seal for nicks, cuts, or distortion. Replace if necessary.

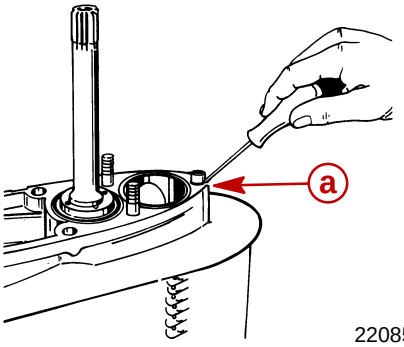


22085

a - Water Tube Seal

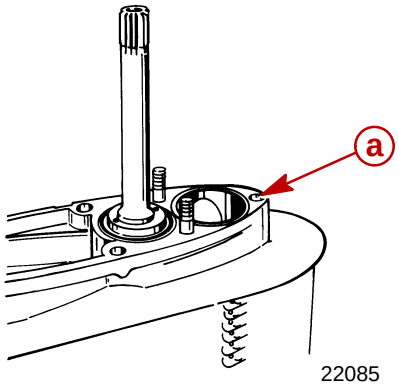
Speedometer Water Tube Seal Replacement

1. Pry rubber seal out with a suitable tool.



a - Rubber Seal

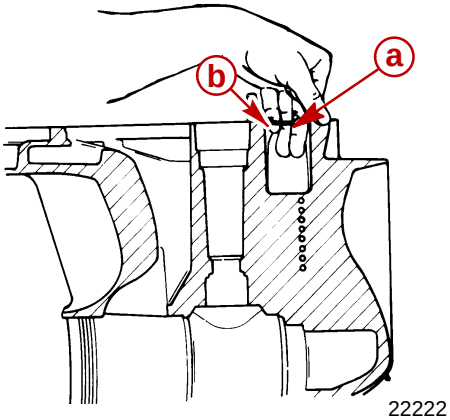
2. Lightly coat O.D. of seal with 3-M adhesive (92-86166-1) and install in speedometer water tube bore. Ensure top edge of seal is flush with gear housing surface.



a - Seal – Seat Flush with Edge of Water Tube Bore

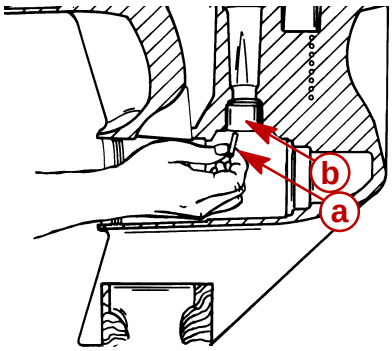
Gear Housing Reassembly and Shimming

1. Lubricate all gears and bearings with gear lube before installing. Components must be lubricated to obtain accurate bearing preload readings.
2. Install water passage O-ring and oil passage quad ring. Hold in place using 3-M Adhesive (P/N 92-86166-1).



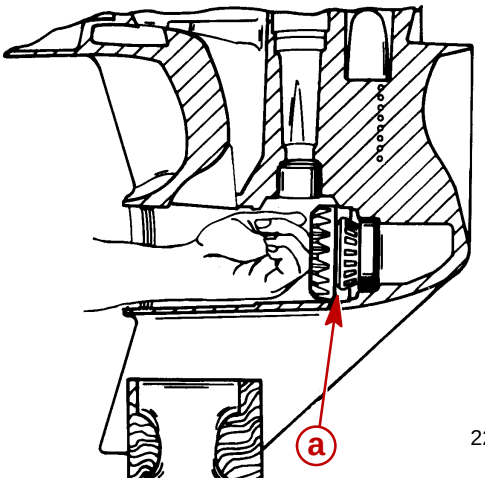
a - Water Passage O-ring
b - Oil Passage Quad Ring

3. **Units with gear housing casting number 1641-8293C1:** pinion needle bearings must be held in place with Needle Bearing Assembly Lubricant. **Check that ALL needle bearings are in race.**



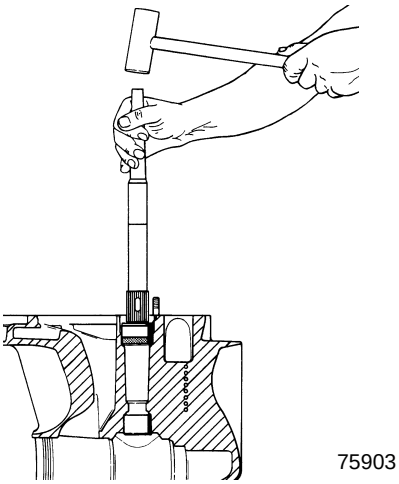
a - Needle Bearing
b - Casing

4. Install driven gear assembly.



a - Driven Gear Assembly

5. Install original shim(s) and drive shaft lower bearing cup, using cup driver (P/N 91-67443), and old drive shaft. Use original shims, or if lost or misplaced, start with .050 in. (1.27mm).



a - Shims
b - Lower Bearing Cup
c - Cup Driver
d - Old Drive Shaft

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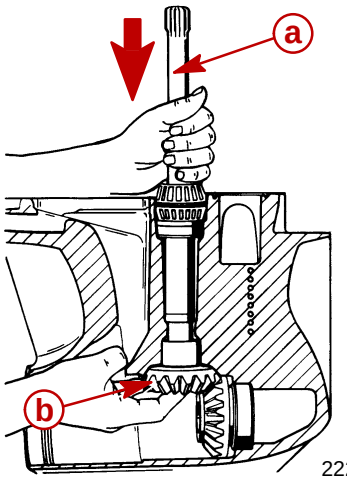
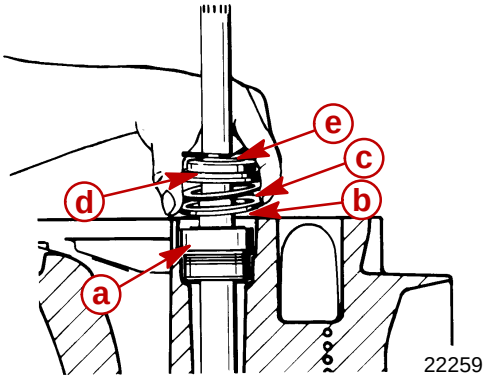
6. Install drive shaft and pinion gear.



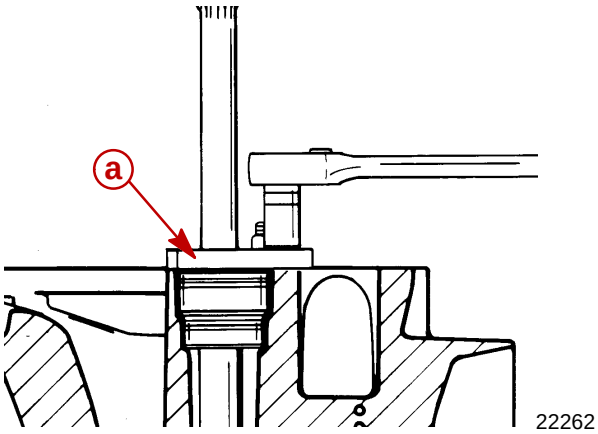
a - Drive Shaft
b - Pinion Gear

7. Install upper bearing cup, tab washer, original shims, spacer, and O-ring. Use original shims, or if lost or misplaced, start with .050 in. (1.27mm).



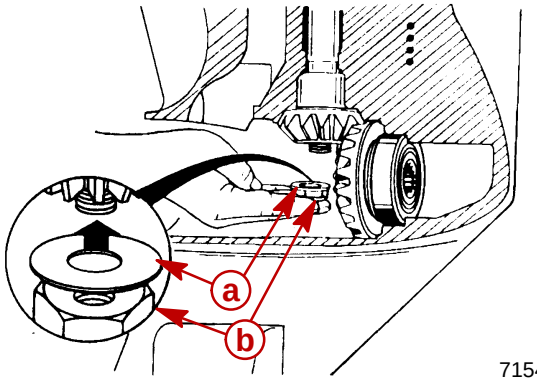
a - Upper Bearing Cup
b - Tab Washer
c - Shims
d - Spacer
e - O-ring

8. Install clamp plate (P/N 91-43559) on gear housing. Tighten securely.



a - Clamp Plate

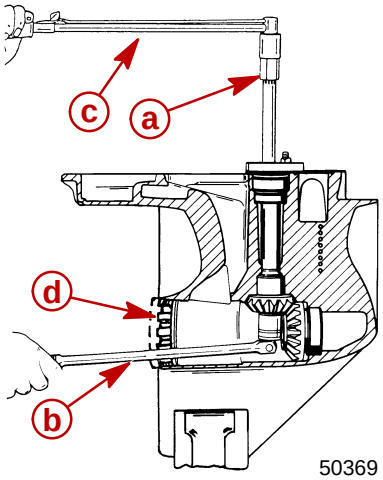
9. Install washer, and new nut. Apply Loctite 27131 to threads of nut.



71543

a - Washer
b - Nut

10. Temporarily install bearing carrier retainer to avoid damage to threads. Torque pinion nut to 100 lb. ft. (136 N·m).



50369

a - Drive Shaft Adaptor Tool (91-61077)
b - Breaker Bar and Socket
c - Torque Wrench and Socket
d - Bearing Carrier Retainer

11. By hand, remove bearing carrier retainer previously placed in unit for protection of threads.

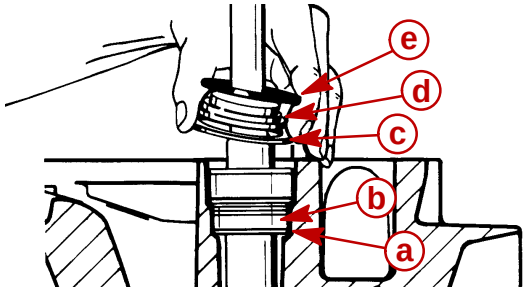
12. Check pinion height.

    a. Rotate drive shaft several times to seat bearings. Insert shimming tool into gear housing.

    b. Measure clearance between tool and gear with feeler gauge. Clearance must be .025 in. (.635mm). Take measurement at 3 locations on gear (120 degrees apart).

    If clearance is less than specified: Add appropriate thickness of shim(s) under lower tapered roller bearing cup. Any thickness added here must be subtracted from shim thickness at upper bearing.

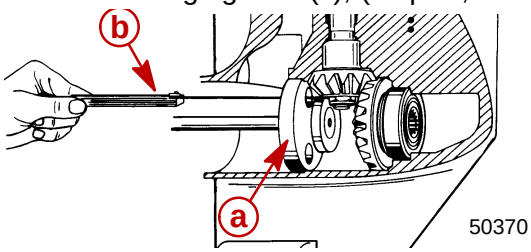
    If clearance is more than specified: Remove appropriate thickness of shim(s) from under lower tapered roller bearing cup.



22262

a - Shims, Lower
b - Bearing Cup, Lower
c - Shims, Upper
d - Spacer
e - O-ring

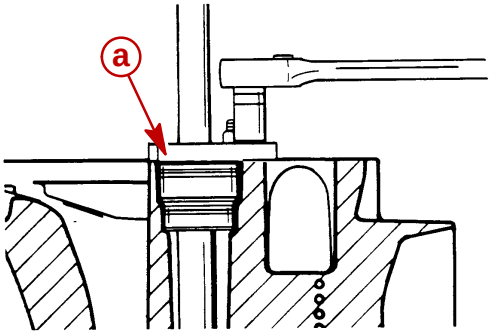
    c. Recheck clearance after changing shim(s), (step “b,” above).



50370

a - Shimming Tool (P/N 91-96512)
b - Feeler Gauge

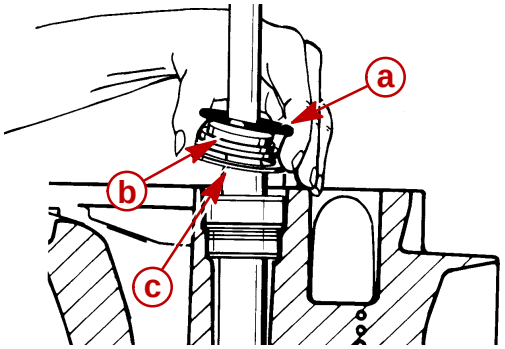
13. Remove clamp plate.



22262

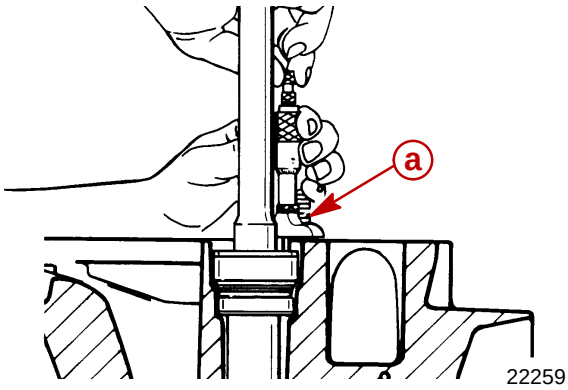
a - Clamp Plate

14. Remove O-ring, spacer, and shims.



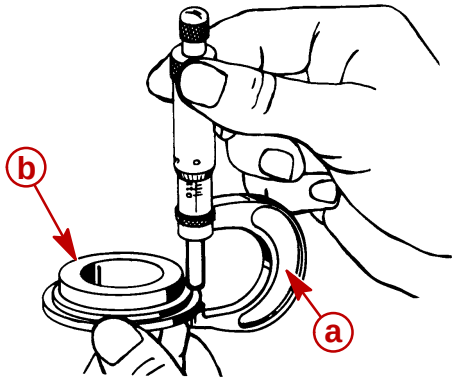
a - O-ring
b - Space
c - Shims

15. Determine shim thickness required for drive shaft bearing preload.
    a. Measure distance between top of gear housing and tab washer.



a - 0-to-1in. Depth Micrometer

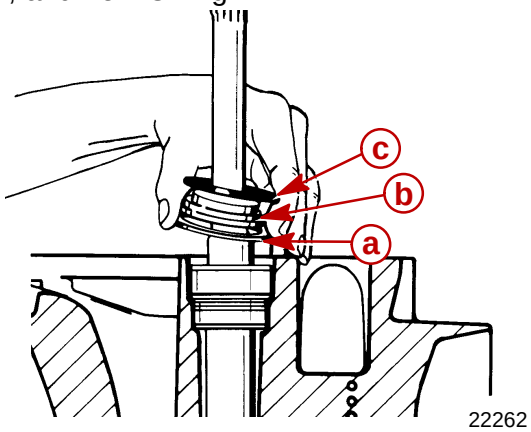
    b. Measure thickness of spacer from top machined surface to bottom machined surface.



a - Outside Micrometer
b - Spacer

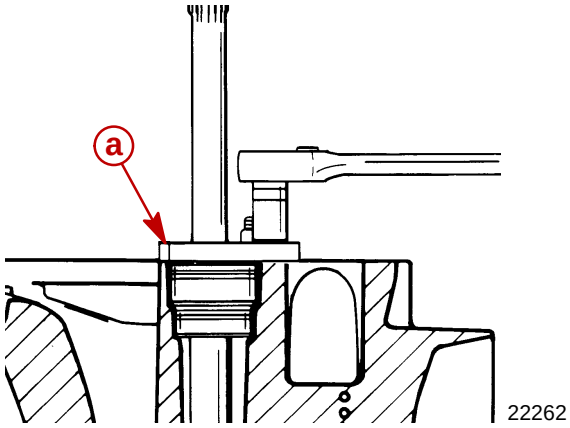
    c. Calculate shim thickness as shown.
    Measurement from “step a” -minus-
    Measurement from “step b” + .001 in. =
    Shim Thickness Required.

16. Install shims, spacer, and new O-ring.



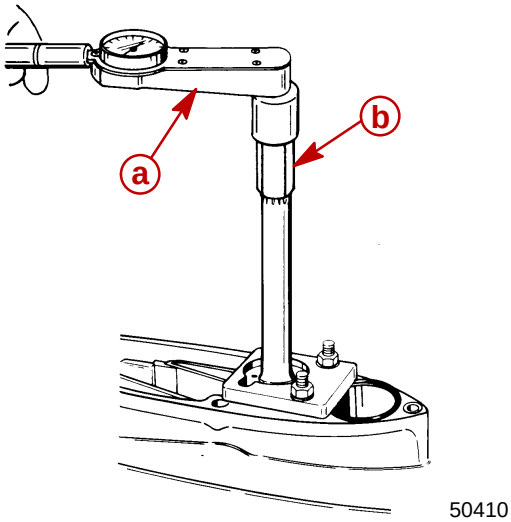
a - Shims
b - Spacer
c - O-ring

17. Reinstall clamping plate on gear housing. Tighten securely.



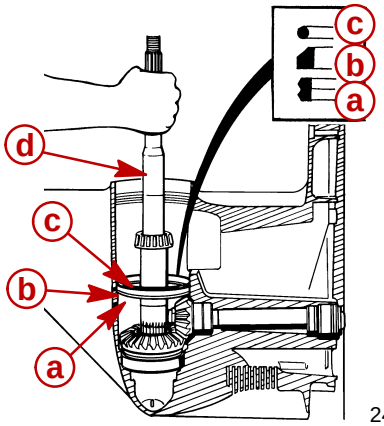
a - Clamp Plate

18. Using a dial-type lb. in. torque wrench, check the rolling preload [3-5 lb. in. (0.3-0.6 N·m)].



a - Dial-type lb. in. Torque Wrench
b - Drive Shaft Adaptor

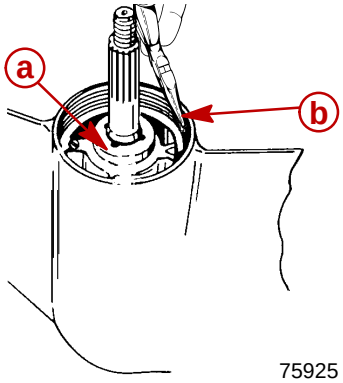
19. Install components as shown.



24211

a - Load Ring
b - Thrust Ring
c - O-ring
d - Propeller Shaft

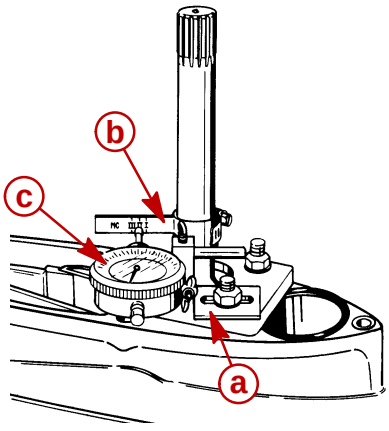
20. Install bearing carrier.



75925

a - Bearing Carrier
b - Locating Key

21. Install and tighten bearing carrier retaining nut until resistance to propeller shaft rotation can be felt (to preload bearings).
22. Driven gear shimming:
    a. Install dial indicator adaptor, (P/N 91-83155), backlash indicator rod, (P/N 91-53459), and dial indicator, (P/N 91-58222A1), as shown. Ensure dial rod is aligned with “II” on indicator rod.



22439

a - Dial Indicator Adaptor
b - Backlash Indicator Rod
c - Dial Indicator

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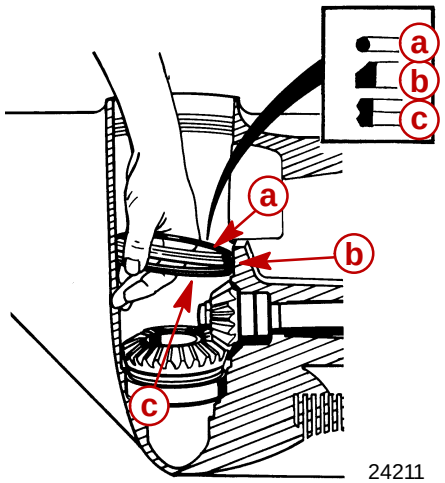
b. Check gear backlash by lightly rotating drive shaft back and forth. Do not allow propeller shaft to turn. Observe dial indicator. Reading should be .009-.015 in. (.23-.38mm).

c. If backlash is not correct, disassemble and proceed as follows:
If backlash is **more** than specified: **Add** shim(s) under driven gear bearing cup.
If backlash is **less** than specified: **Remove** shim(s) under driven gear bearing cup.

d. Recheck backlash reading after reassembly.

23. Remove bearing carrier and items shown. Reinstall items shown using **new** load ring.

IMPORTANT: Always use a new load ring when reassembling.

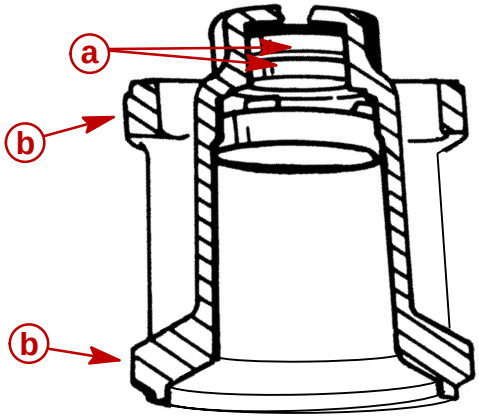


24211

a - O-ring
b - Thrust Ring
c - Load Ring

IMPORTANT: Bearing carrier and threads on retainer must be lubricated to prevent corrosion and cracking in gear housing. Use Special Lubricant 101 on retainer; coat O.D. on carrier “rounds” (b) with Perfect Seal.

24. Lubricate bearing carrier seals.

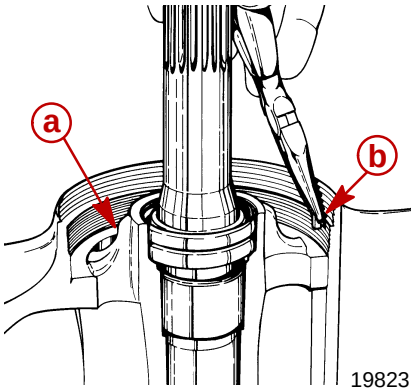


75926

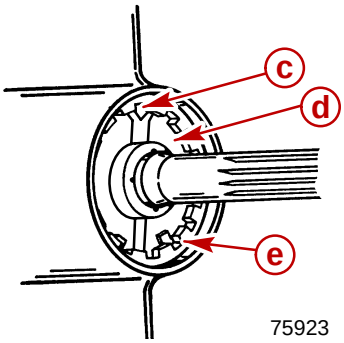
a - Space Between Seals – Fill With 2-4-C Marine Lubricant with Teflon
b - Mating Surfaces – Coat Carrier “Rounds” with Perfect Seal

25. Install bearing carrier and tab washer in gear housing.

26. Lubricate threads on bearing carrier retaining nut with Special Lubricant 101. Install, and tighten bearing carrier retainer nut until resistance to propeller shaft rotation can be felt (to preload bearings).



a - Bearing Carrier
b - Locating Key



c - Tab Washer – “V” Notch in Recess in Carrier
d - Bearing Carrier
e - Bearing Carrier Retainer

27. Tighten the retainer to the proper overall preload. To determine overall gear case preload, add propeller shaft bearing preload to drive shaft bearing preload as outlined in the example below.

IMPORTANT: The overall preload includes both the drive shaft preload and the gear case preload.

Preloads	
New Propeller Shaft Bearings	8-12 lb. in. (.9-1.4 N·m)**
Used Propeller Shaft Bearings*	5-8 lb. in. (.6-.9 N·m)**
Drive Shaft Bearings	3-5 lb. in. (.3-.6. N·m)

* Bearing is considered used if spun under load even once (“under load” meaning: “with power applied”).

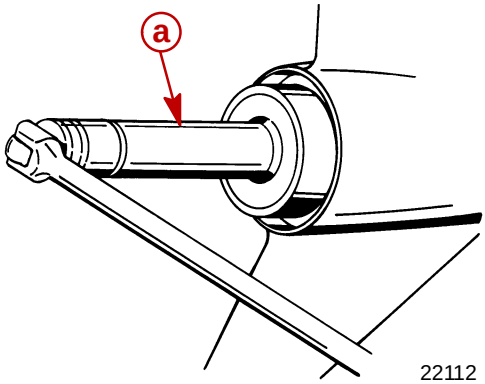
** Plus drive shaft preload of 3-5 lb. in. (.3-.6 N·m)

Example:

Drive Shaft Preload 3 lb. in. (.3 N·m)
+
New Bearing Preload 8 lb. in. (.9 N·m)
11 lb. in. (1.2 N·m)

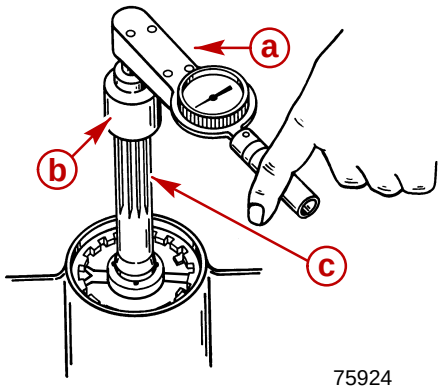
Tighten the retainer to the proper preload using the following procedure.

a. Tighten retainer in small increments.



a - Bearing Carrier Retainer Wrench (91-17257)

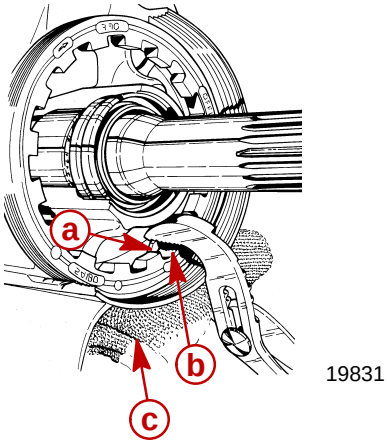
b. After tightening, check overall gear housing bearing preload at propeller shaft, each time.



a - Lb. in. Torque Wrench 91-66274
b - Propeller Nut (under socket)
c - Rotate Shaft in Direction of Normal Rotation Using a Smooth, Steady Motion

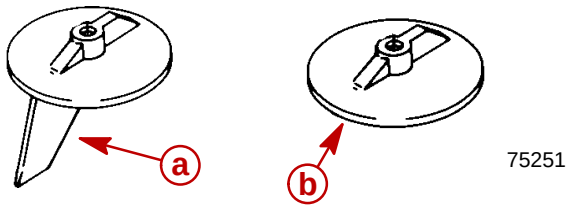
c. Continue tightening bearing carrier retainer until specified bearing preload is attained.

28. Bend one tab into retaining nut as shown after propeller shaft preload has been set correctly. Bend remaining tabs down into gear housing.



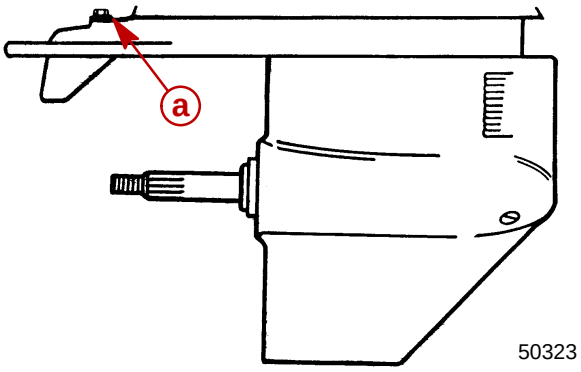
a - Tab Washer Tab
b - Groove in Retainer
c - Cushioning, to avoid chipping or scratching paint

NOTE: *Later model Bravo Two drive units are equipped with an anodic plate instead of trim tab. Replacement procedure is the same.*



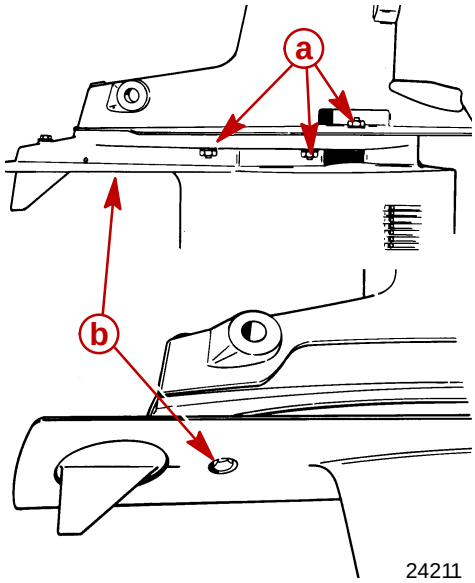
a - Trim Tab
b - Anodic Plate

29. Install trim tab or anodic plate. Torque screw to 23 lb. ft. (32 N·m).



a - Screw

30. Install gear housing to drive shaft housing. Torque fasteners to 35 lb. ft. (47 N·m).



a - 6 Nuts and Washers (3 Each Side)
b - 1 Bolt

31. Reinstall drive unit. Refer to Section 2A.

32. Fill drive unit with Gear Lube. Refer to Section 1B.

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STERNDRIVE UNIT

Section 3D - Bravo Three Gear Housing

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3 D

Specifications

Torque Specifications

NOTE: *Securely tighten all fasteners not listed below.*

DESCRIPTION	TORQUE		
	lb. in.	lb. ft.	N·m
Drive Shaft Pinion Gear (Bolt)		40-45	54.2-61
Bearing Carrier (Left-Hand Thread)		150	203
Outer Propeller Shaft Bearing Retainer Nut (Left-Hand Thread)		200	271
Drive Shaft Housing to Gear Housing Nuts and Bolt		35	47.5
Oil Fill/Drain Screw	30-50		3.4-5.6
Front Propeller Nut		100	136
Rear Propeller Nut		60	81

Lubricants/Sealers/Adhesives

Description	Part Number
Quicksilver 2-4-C Marine Lubricant with Teflon	92-825407A2
Quicksilver Special Lubricant 101	92-13872A1
3-M Adhesive	92-86166-1
Loctite 27131	92-809820
Quicksilver High Performance Gear Lube	92-19007A24
Needle Bearing Assembly Lubricant	92-825265A1
Quicksilver Perfect Seal	92-34227-1
Loctite 242	Obtain Locally

Bearing Preloads

DESCRIPTION	TORQUE	
	lb. in.	N·m
Drive Shaft Bearing	3-5	0.3-.6
Overall Preload Checked at Inner Propeller Shaft (New Bearings)	8-18*	0.9-2*
Overall Gear Case Preload Checked at Inner Propeller Shaft (Used Bearings)**	5-15*	0.6-1.7*

*Includes drive shaft preload

** A bearing is used if spun once under load.

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Gear Ratio - Teeth per Gear (Gear Housing)

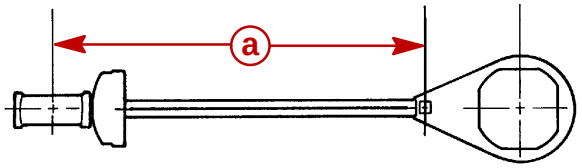
RATIO	DRIVE	DRIVEN	DRIVEN
Use Tool Position 16:27			
2.43:1	13	24	24
2.20:1	16	27	27
2.00:1	16	27	27
1.81:1	16	27	27
1.65:1	18	25	25
Use Tool Position 15:19			
1.50:1	15	19	19
1.36:1	15	19	19

Special Tools

Description	Part No.
Dial Indicator Set	91-58222A1
Slide Hammer Puller	91-34569A1
Torque Wrench (lb. in.)	91-66274
Clamp Plate	91-43559
Universal Puller Plate	91-37241
Threaded Rod	91-31229
Bearing Driver	91-89867
Bearing Driver	91-89868
Bearing Cup Driver	91-67443
Backlash Indicator Rod (Inner Propeller Shaft)	91-805481
Backlash Indicator Rod (Outer Propeller Shaft)	91-805482
Bearing Carrier Installation / Removal Tool	91-805374--1
Drive Shaft Pinion Bearing Driver	91-63638
Outer Propeller Shaft Bearing Installation Tool	91-805352
Outer Propeller Shaft Seal installation Tool	91-805358
Bearing Carrier Seal Installation Tool	91-805372
Front Bearing Race Driver Rod	91-805454
Propeller Nut Installation Tool	91-805457-1
Shimming Tool	91-805462
Drive Shaft Retaining Tool	91-805381
Driver Rod	91-37323
Outer Propeller Shaft Bearing Retainer Installation Tool	91-805382
Bearing Carrier Bearing Installation Tool	91-805356
Drive Shaft Adaptor Tool	91-56775
Forward Bearing Driver	91-31106
Driver Guide	91-805470
Bearing Carrier Tool	91-805374

TORQUE CONVERSION CHART FOR BEARING CARRIER

Torque Wrench Length in Inches (mm) (a)	Torque Wrench Reading in Lb. Ft. (N·m) to Achieve 150 Lb. Ft. (203 N·m)
15 (381)	122 (165)
16 (406)	123 (167)
17 (432)	124 (168)
18 (457)	126 (171)
19 (483)	127 (172)
20 (508)	128 (174)
21 (533)	129 (175)
22 (559)	129 (175)
23 (584)	130 (176)
24 (610)	131 (178)
25 (635)	132 (179)
26 (660)	132 (179)
27 (686)	133 (180)
28 (711)	133 (180)
29 (737)	134 (182)
30 (762)	134 (182)
31 (787)	135 (183)
32 (813)	135 (183)
33 (838)	136 (184)
34 (864)	136 (184)
35 (889)	136 (184)
36 (914)	137 (186)



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a - Torque Wrench Length

TORQUE CONVERSION CHART FOR BEARING RETAINER NUT

Torque Wrench Length (A) in Inches (mm) (a)	Torque Wrench Reading in Lb. Ft. (N·m) to Achieve 200 lb. ft. (271 N·m)
15 (381)	162(220)
16 (406)	164 (222)
17 (432)	166 (225)
18 (457)	167 (226)
19 (483)	169 (229)
20 (508)	170 (230)
21 (533)	171 (232)
22 (559)	173 (235)
23 (584)	174 (236)
24 (610)	175 (237)
25 (635)	175 (237)
26 (660)	176 (239)
27 (686)	177 (240)
28 (711)	178 (241)
29 (737)	178 (241)
30 (762)	179 (243)
31 (787)	180 (244)
32 (813)	180 (244)
33 (838)	181 (245)
34 (864)	181 (245)
35 (889)	182 (247)
36 (914)	182 (247)

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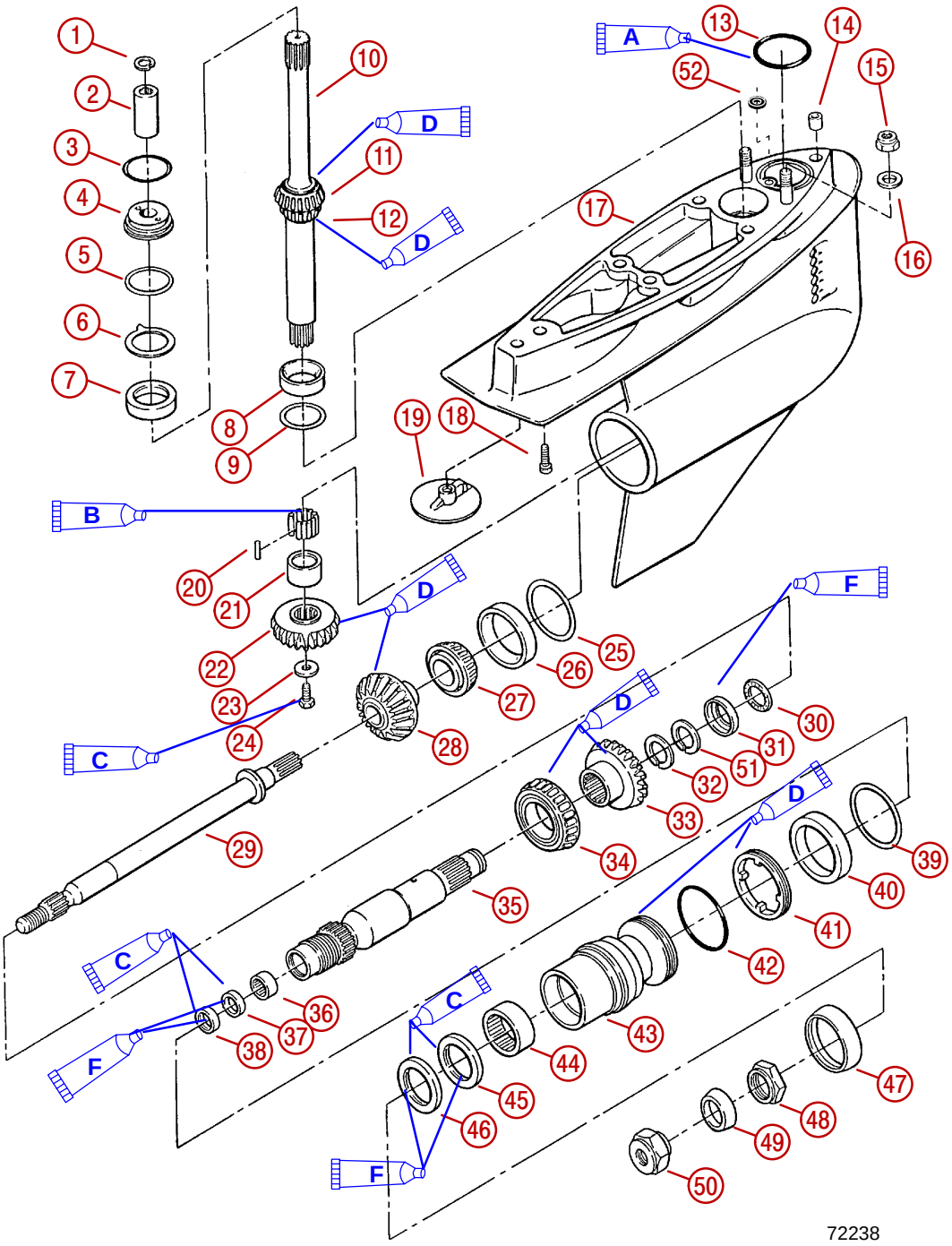
Torquing Outer Prop Shaft Bearing Retainer and Bearing Carrier

Use the following procedure to allow torquing outer prop shaft bearing retainer and bearing carrier with a torque wrench.

1. On beam-type torque wrenches, measure from square drive to fulcrum (pivot) point of handle.
2. On click-stop or dial type torque wrenches, measure from square drive to reference mark on handle (two bands, etc.).

Bravo Three Gear Housing Exploded View

Drive Shaft and Propeller Shaft Components



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1 - Retainer
2 - Coupler
3 - O-ring
4 - Spacer
5 - Shim(s)
6 - Tab Washer
7 - Bearing Cup
8 - Bearing Cup
9 - Shim(s)
10- Drive Shaft
11- Tapered Roller Bearing (Larger Dia.)
12- Tapered Roller Bearing (Smaller Dia.)
13- O-ring
14- Seal
15- Locknut
16- Flat Washer
17- Gear Housing
18- Screw
19- Anodic Plate
20- Needle Bearings
21- Bearing Race
22- Pinion (Drive)
23- Washer
24- Bolt
25- Shim(s)
26- Bearing Cup
27- Tapered Bearing
28- Front Gear
29- Inner Propeller Shaft
30- Thrust Bearing
31- Thrust Race
32- Snap Ring
33- Rear Gear
34- Tapered Bearing
35- Outer Propeller Shaft
36- Bearing
37- Oil Seal
38- Oil Seal
39- Shim(s)
40- Bearing Cup
41- Bearing Retainer (Nut)
42- O-ring
43- Bearing Carrier
44- Bearing
45- Oil Seal
46- Water Seal
47- Front Propeller Thrust Washer
48- Front Propeller Locknut
49- Rear Propeller Thrust Washer
50- Rear Propeller Locknut
51- Shim (Prop Shaft End-Play)
52- Oil Passage Quad Ring

LUBRICANTS, SEALERS, ADHESIVES

A 3M Brand Adhesive 92-86166-1

B Quicksilver Needle Bearing Assembly Lubricant 92-825265A1

C Loctite 27131 92-809820

D Quicksilver High Performance Gear Lube (Use on all bearing surfaces) 92-816026A4

E Quicksilver Special Lubricant 101 . . . . . 92-13872A1

F Quicksilver 2-4-C Marine Lubricant with Teflon 92-825107A12

TORQUE SPECIFICATIONS

(a) 100 lb. ft. (136 N·m)

(b) 200 lb. ft. (271 N·m) - See Chart page 3D-4

(c) 150 lb. ft. (203 N·m) - See Chart page 3D-4

(d) 35 lb. ft. (48 N·m)

(e) 60 lb. ft. (81 N·m)

(f) 40-45 lb. ft. (54.2-61 N·m)

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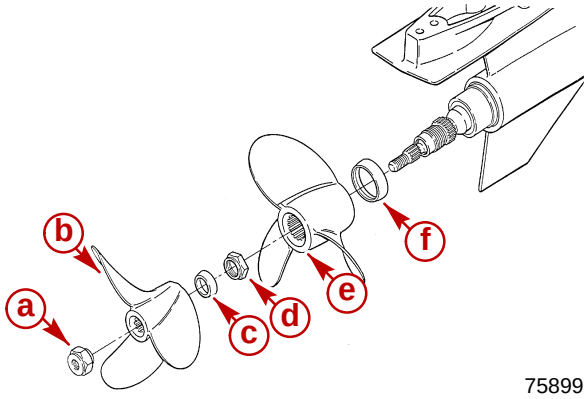
Pre-Disassembly Inspection

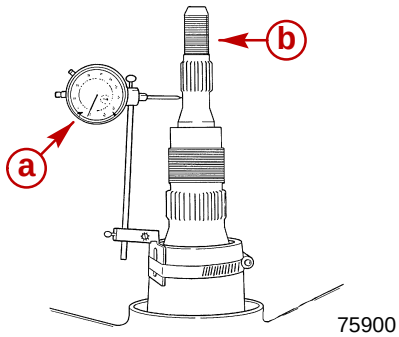
1. Remove propellers.



75899

a - Rear Propeller Nut
b - Rear Propeller
c - Rear Propeller Centering Ring
d - Front Propeller Nut
e - Front Propeller
f - Front Propeller Centering Ring

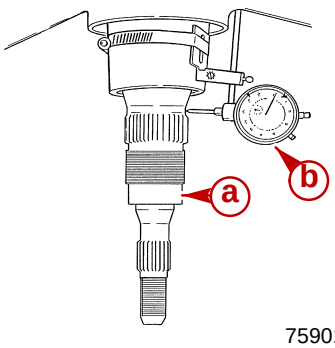
2. Check for bent propeller shafts as follows:
   a. **Inner Shaft - Position Unit with Shafts Positioned Up.** Position dial indicator on inner propeller shaft. Rotate inner propeller shaft while observing dial indicator. If deflection is more than .005 in. (0.127 mm), a bent inner propeller shaft is indicated.



75900

a - Dial Indicator
b - Inner Propeller Shaft

   b. **Outer Shaft - Position Unit with Shafts Positioned Down.** Position dial indicator on outer propeller shaft. Rotate outer propeller shaft while observing dial indicator. If deflection is more than .010 in. (0.254 mm), a bent outer propeller shaft is indicated.



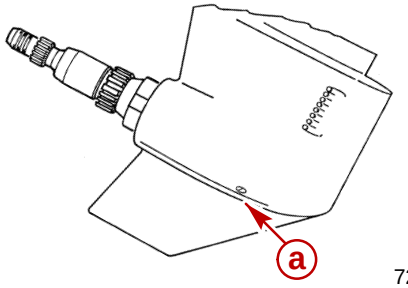
75901

a - Dial Indicator
b - Outer Propeller Shaft

index

Gear Housing Disassembly

1. **Gear Lube Monitor models, only:** Remove, empty and clean gear lube monitor. Lubricate neck O-ring seal with Quicksilver High Performance Gear Lube before replacing monitor cap.
2. Drain drive unit at fill/drain screw.



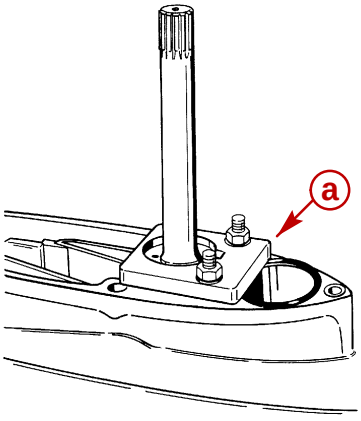
72522

a - Fill/Drain Screw

⚠ CAUTION

Clamp plate must be installed on gear housing when gear housing is separated from drive shaft housing.

3. Install clamp plate on gear housing. Tighten securely.



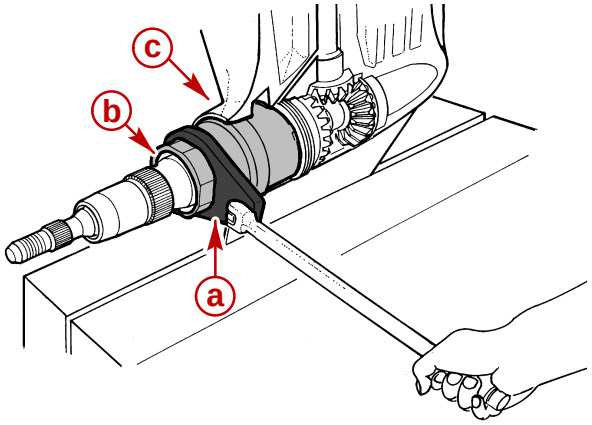
72241

a - Clamp Plate (91-43559)

⚠ CAUTION

Bearing carrier has a LEFT-HAND THREAD. Remove by turning CLOCKWISE.

4. Remove bearing carrier, by turning clockwise, using bearing carrier tool. Use a torch-lamp to heat area where the carrier and housing meet.



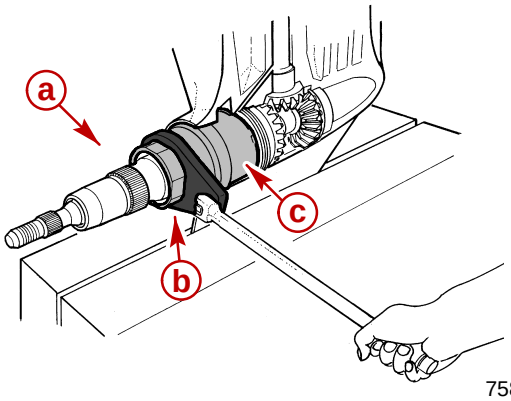
75898

a - Bearing Carrier Tool (91-805374--1)
b - Bearing Carrier
c - Heat with a Torch Lamp

⚠ CAUTION

Outer propeller shaft bearing retainer has a LEFT- HAND THREAD. Remove by turning CLOCKWISE.

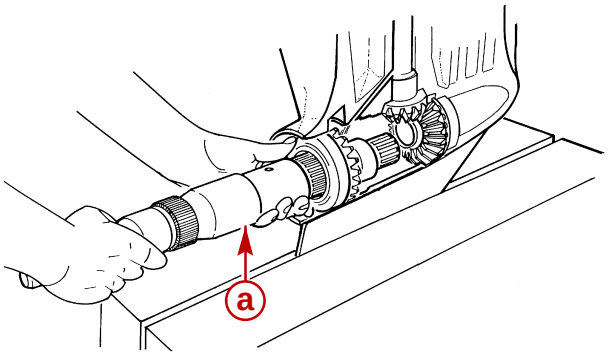
5. Remove outer propeller shaft bearing retainer, by turning clockwise, using outer propeller shaft bearing retainer tool.



75898

a - Bearing Retainer Tool (P/N 91-805382)
b - Bearing Carrier Tool (P/N 91-805374)
c - Bearing Retainer

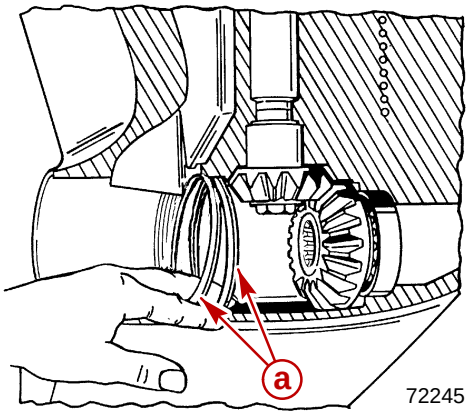
6. Remove inner and outer propeller shaft assembly from gear housing.



72244

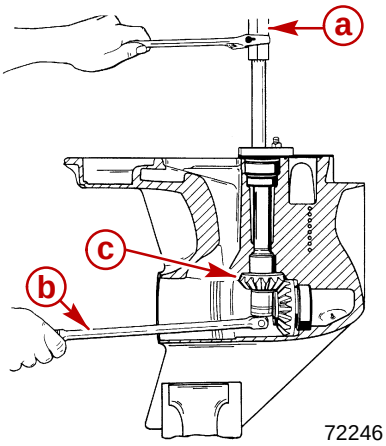
a - Inner and Outer Propeller Shaft Assembly

7. Remove shims from gear housing.



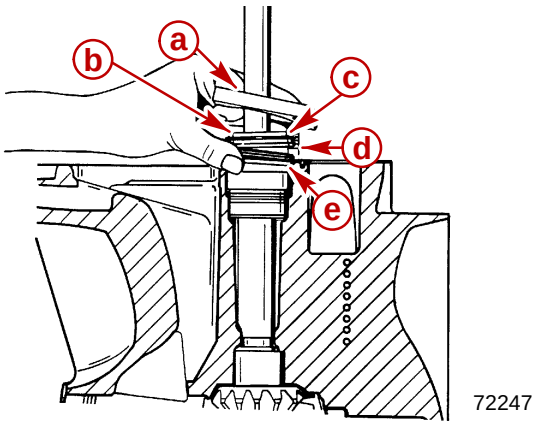
a - Shims

8. Remove drive shaft pinion gear retaining bolt and washer using drive shaft adaptor tool.



a - Drive Shaft Adaptor Tool (91-61077)
b - Breaker Bar and Socket
c - Pinion Gear

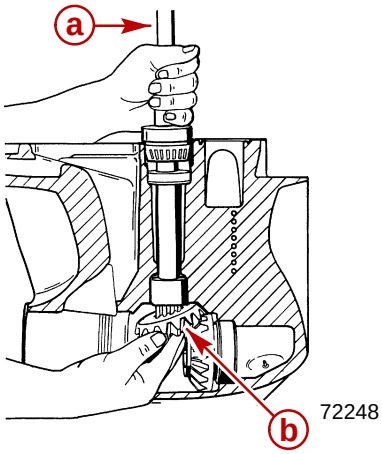
9. Remove clamp plate installed in Step 2, then remove O-ring, spacer, shim(s) and tab washer.



a - Clamp Plate
b - O-ring
c - Spacer
d - Shim(s)
e - Tab Washer

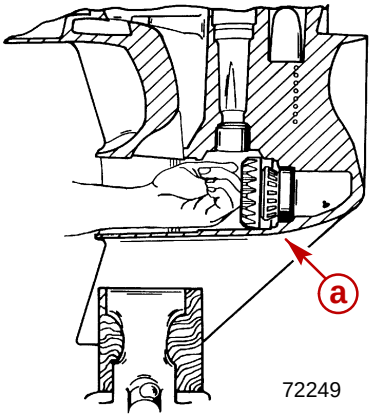
10. Remove drive shaft and pinion gear.

NOTE: *Be careful not to lose rollers from drive shaft pinion bearing should they drop during drive shaft removal.*



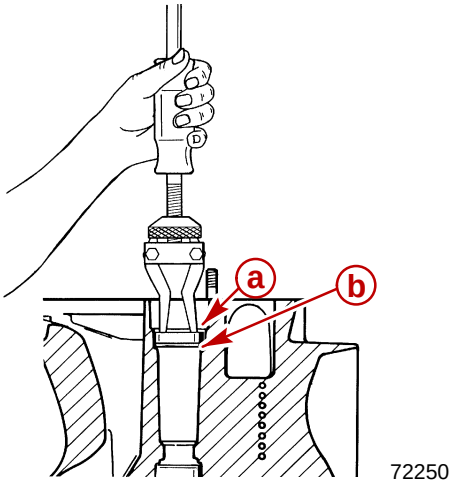
a - Drive Shaft
b - Drive Shaft Pinion Gear

11. Remove front driven gear and bearing from gear housing.



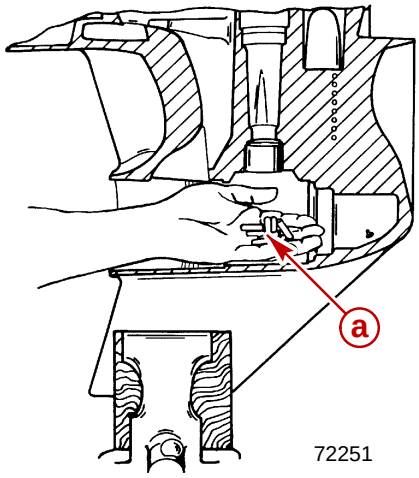
a - Front Pinion Gear and Bearing

12. Remove drive shaft bearing cup and shim(s).



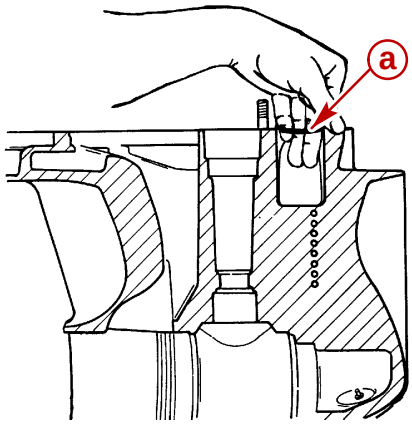
a - Bearing Cup
b - Shim(s)

13. Unless you intend to remove the entire pinion bearing, remove needle bearings from pinion bearing race.



a - Needle Bearings

14. Remove water passage O-ring and oil passage quad ring.



a - Water Passage O-Ring

Component Servicing

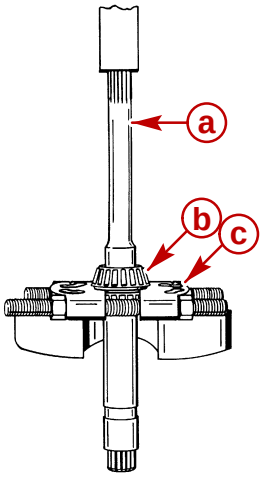
Drive Shaft and Pinion Bearing Inspection and Cleaning

1. The condition of the drive shaft tapered bearing cups is an indication of the condition of the tapered roller bearings on the drive shaft. Replace bearing and bearing cup if cup is pitted, grooved, scored, worn uneven, discolored from overheating, or has embedded metal particles.
2. The condition of the bearing surface on drive shaft at needle bearing location is an indication of the condition of needle bearings. Replace needles and sleeve if pitted, grooved, scored, worn uneven, discolored from overheating, or has embedded metal particles.
3. Inspect splines for worn or twisted condition. Replace drive shaft if either condition exists.
4. Clean all parts that are to be reused with solvent. Dry parts completely using compressed air, being careful not to spin bearings.

Drive Shaft Disassembly

NOTE: *Bearing assembly must be replaced if removed from drive shaft. Tapered roller bearings are damaged when removed.*

1. Press tapered roller bearing from shaft using universal puller plate to support bearing. Remove second tapered roller bearing in the same manner.



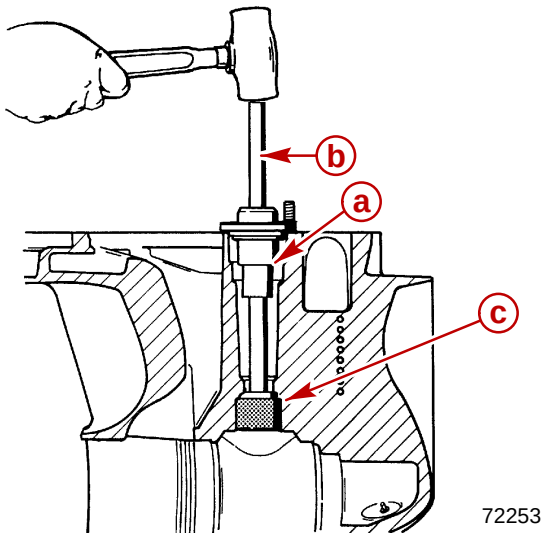
72442

a - Drive Shaft
b - Bearing
c - Universal Puller Plate (P/N 91-37241)

Pinion Bearing Removal

IMPORTANT: All needle bearings MUST BE in place inside bearing casing while driving pinion bearing from gear housing or bearing casing will bend or break and become difficult to remove.

1. Remove pinion bearing from gear housing using tools as shown. Heat bearing area of housing to approximately 200°F (93.3°C) to ease removal. DO NOT use open flame.

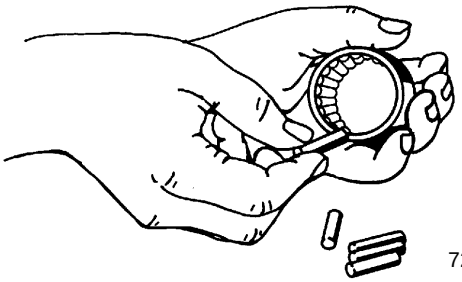


72253

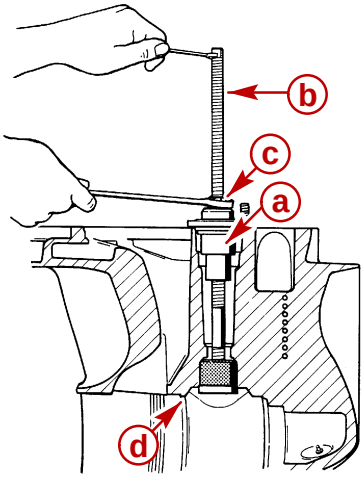
a - Bearing Driver (P/N 91-89868) - Used as Pilot
b - Driver Rod (P/N 91-37323)
c - Bearing Remover (P/N 91-90337) - Ensure Tabs Align with Slots in Gear Housing

Pinion Bearing Installation

1. Install needles in casing. Use Needle Bearing Assembly Lubricant to help keep needles in place. Position bearing assembly over bearing driver with number on bearing casing facing up. Coat casing O.D. with Quicksilver High Performance Gear Lube.


72443

2. Install pinion bearing using tools as shown.

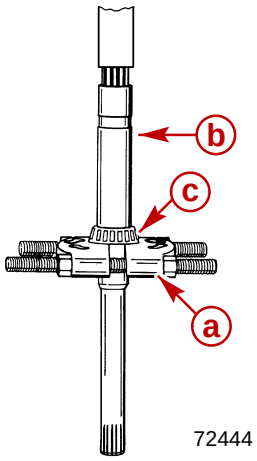


72254

a - Bearing Driver (P/N 91-89868) - Used as Pilot
b - Threaded Rod (P/N 91-31229)
c - Washer and Nut
d - Bearing Driver (P/N 91-89867)

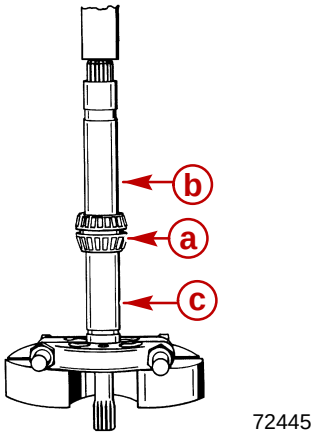
Drive Shaft Reassembly

1. Lubricate I.D. of small tapered roller bearing with Quicksilver High Performance Gear Lube. Press small tapered roller bearing onto drive shaft. Ensure smaller O.D. faces pinion end of shaft.



a - Universal Puller Plate (P/N 91-37241)
b - Drive Shaft
c - Small Tapered Roller Bearing

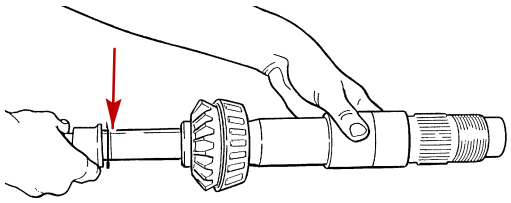
2. Lubricate I.D. of large tapered roller bearing with Quicksilver High Performance Gear Lube. Press large tapered roller bearing onto drive shaft. Ensure larger O.D. faces pinion end of shaft.



a - Suitable Mandrel
b - Drive Shaft
c - Large Tapered Roller Bearing

Propeller Shaft Disassembly

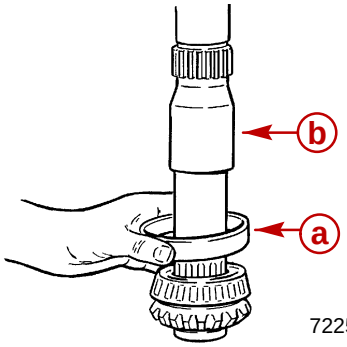
1. Remove inner propeller shaft and thrust bearing from assembly.



72255

a - Inner Propeller Shaft
b - Thrust Bearing

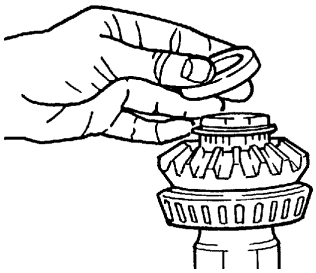
2. Remove bearing cup from outer propeller shaft.



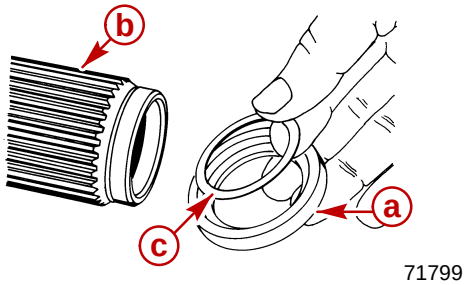
72256

a - Bearing Cup
b - Outer Propeller Shaft

3. Remove thrust cap using a punch (align punch with opening in snap-ring) and hammer.



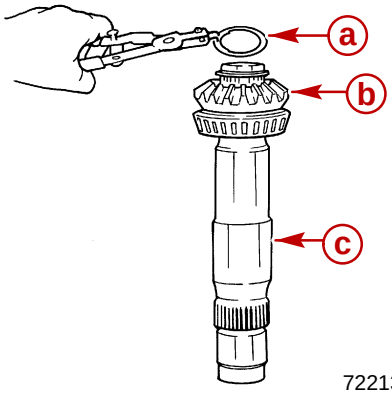
72212



71799

a - Thrust Cap
b - Outer Propeller Shaft
c - Shim

4. Remove snap ring, and driven gear and bearing assembly from outer propeller shaft.



72213

a - Snap Ring
b - Driven Gear and Bearing Assembly
c - Outer Propeller Shaft

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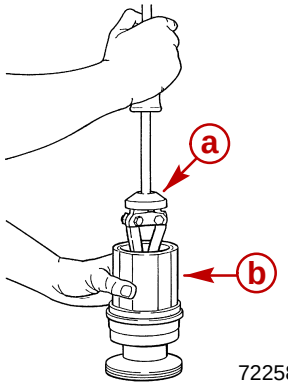
Bearing Carrier Inspection

1. Check bearing carrier for signs of corrosion, especially on gear housing to bearing carrier mating surfaces. If corrosion is evident, replace bearing carrier.
2. Inspect needle bearing for pitting, grooves, discoloration or embedded particles. If any of these conditions exist, replacement is necessary.

Bearing Carrier Servicing

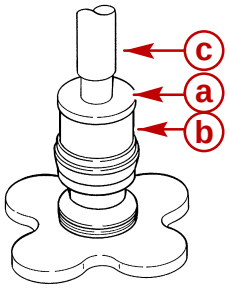
1. Remove two seals using a three-jaw puller and then, if needed; remove bearing in the same manner.



72258

a - Slide Hammer Puller
b - Bearing Carrier

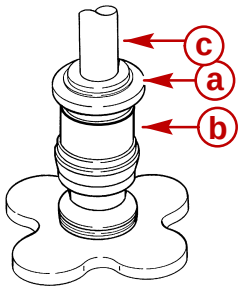
2. Apply gear lube to O.D. of bearing and install roller bearing using bearing installation tool.



75896

a - Bearing Installation Tool (P/N 91-805356)
b - Bearing Carrier
c - Arbor Press

3. Coat O.D. of oil seals with Loctite 27131 and press oil seals into bearing carrier with lips of seals facing opposite each other (inner seal with lips facing in and outer seal with lips facing out), using seal installation tool until tool bottoms out against housing. Lubricate lips of oil seals and between seals with Quicksilver Special Lubricant 101.



75897

a - Seal Installation Tool (P/N 91-805372)
b - Bearing Carrier
c - Arbor Press

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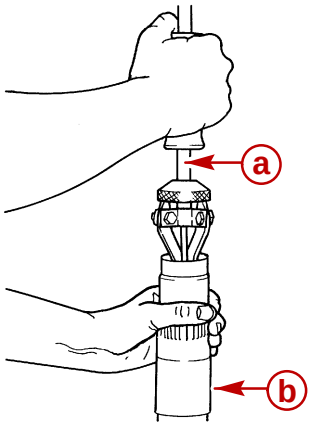
Propeller Shaft Inspection

1. Inspect for bent or twisted splines.
2. Inspect surface of shaft where bearing carrier oil seal lips contact shaft. Replace oil seals if any grooves are found.
3. Inspect needle bearing race on outer propeller shaft and bearing surface of inner propeller shaft for pitting, grooves, discoloration or embedded particles. If any of these conditions exist, replace shaft.
4. Condition of the bearing surfaces on the outer propeller shaft and inner propeller shaft is an indication of the condition of the bearings in the bearing carrier and outer propeller shaft. Inspect bearing rollers for pitting, grooves, discoloration or embedded particles. If any of these conditions exist, replace bearings and shaft.
5. Inspect outer propeller shaft tapered bearing and bearing cup. Replace bearing and bearing cup if cup is pitted, grooved, scored, worn uneven, discolored from overheating, or has embedded metal particles.

Outer Propeller Shaft Servicing

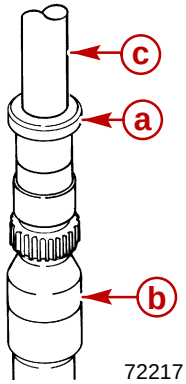
1. To remove roller bearing and two oil seals from outer propeller shaft, use slide hammer puller with three-jaw pullers and pull bearing and oil seals from outer propeller shaft.



72216

a - Slide Hammer Puller (P/N 91-34569A1)
b - Outer Propeller Shaft

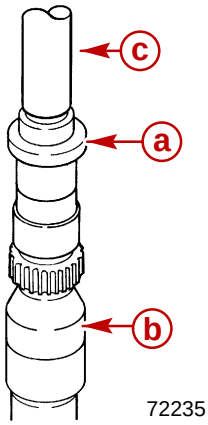
2. Install roller bearing using bearing installation tool.



72217

a - Bearing Installation Tool (P/N 91-805352)
b - Outer Propeller Shaft
c - Arbor Press

3. Coat O.D. of oil seals with Loctite 27131 and press oil seals into outer propeller shaft with lips of seals facing opposite each other (inner seal with lips facing in and outer seal with lips facing out), using seal installation tool until tool bottoms out against shaft. Lubricate lips of oil seals and in between seals with Quicksilver Special Lubricant 101.



72235

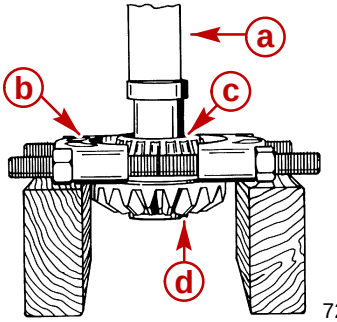
a - Seal Installation Tool (P/N 91-805358)
b - Outer Propeller Shaft
c - Arbor Press

Front and Rear Driven Gear and Bearing Inspection

1. Inspect driven gears for pitting, chipped or broken teeth, and excessive or uneven wear. If any of these conditions exist, replace both gear and bearing assemblies and drive shaft pinion gear.
2. Replace tapered roller bearings and cups if cups are pitted, grooved, scored, worn uneven, discolored from overheating, or have metal particles embedded in the cups.

Front and Rear Driven Gear Bearing Replacement

1. If you determine by inspection that bearings are in need of replacement and the gears are still in good condition, remove bearings from gears using puller plate and a suitable mandrel (bearings are damaged in removal and should not be reused).

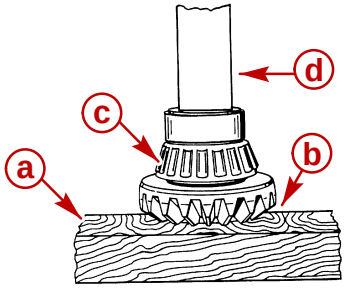


72446

a - Suitable Mandrel
b - Universal Puller Plate (P/N 91-37241)
c - Tapered Roller Bearing
d - Driven Gear

2. Replace tapered roller bearings as follows:

   a. Apply a light coat of Quicksilver High Performance Gear Lube to I.D. of new bearing. Place a suitable mandrel (old bearing race) against new bearing race. Place another mandrel on face of gear and press gear and bearing together.



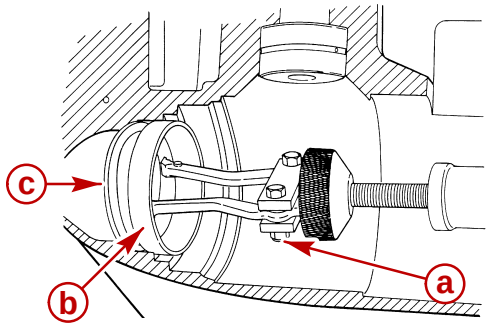
72447

a - Hardwood or Metal Block
b - Driven Gear
c - Tapered Roller Bearing
d - Mandrel - Contacting Inner Race

Front Driven Gear Bearing Cup Removal and Inspection

1. Remove bearing cup and shims. Replace tapered roller bearing and cup if cup is pitted, grooved, scored, worn uneven, discolored from overheating, or has metal particles embedded in the cup.

NOTE: *When pulling bearing cup with puller, shims will be damaged. DO NOT reuse shims.*



19808

a - Slide Hammer Puller (P/N 91-34569A1)
b - Bearing Cup
c - Shims

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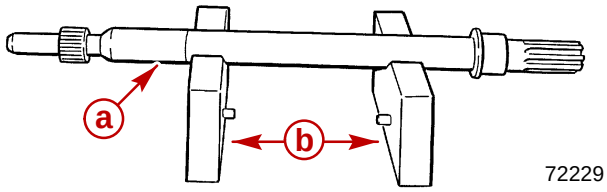
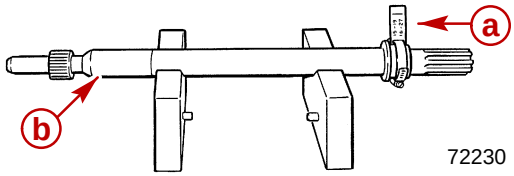
Propeller Shaft Spline Lash Check

1. Check inner propeller shaft spline lash as follows:
   a. Place inner propeller shaft on two V-blocks.



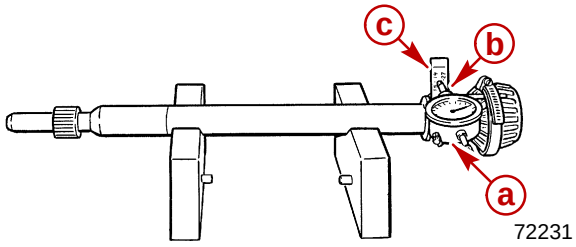
a - Inner Propeller Shaft
b - V-Blocks

   b. Install indicator rod on inner propeller shaft just behind shaft spline.



a - Indicator Rod
b - Inner Propeller Shaft

   c. Slide front driven gear assembly on spline of inner propeller shaft.
   d. Mount dial indicator to gear and position so that indicator probe aligns with mark on indicator rod.

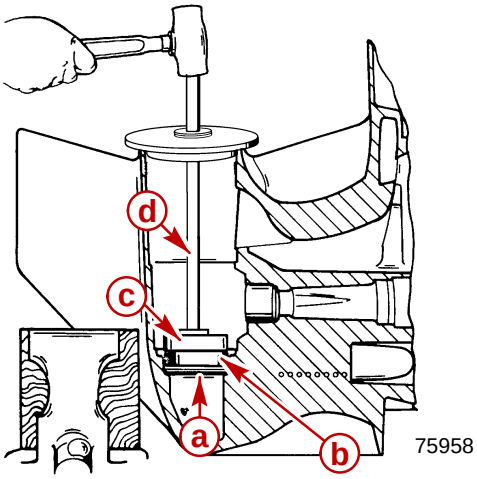


a - Dial Indicator
b - Indicator Rod
c - Mark Stamped on Indicator Rod

   e. Rotate gear back and forth while observing dial indicator. Record spline lash reading (for use later in this section). This reading is required to determine true backlash between pinion and driven gear.
2. Check outer propeller shaft spline lash following the same procedures as for the inner propeller shaft listed in Steps “a” through “e” above.

Front Driven Gear Bearing Cup Installation

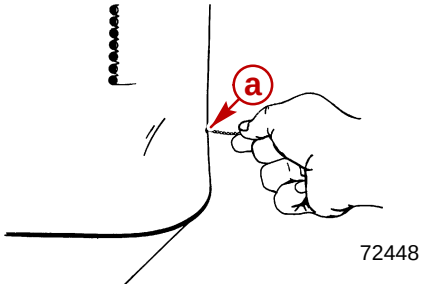
1. Install front driven gear bearing cup with original thickness shims. If shims were lost or ruined where original thickness cannot be determined, install a .015 in. (0.38 mm) shim for a starting point. Ensure cup is not canted. Coat cup O.D. with Quicksilver High Performance Gear Lube.



a - Shim(s)
b - Bearing Cup
c - Driver (P/N 91-805454)
d - Old Propeller Shaft or Driver Rod

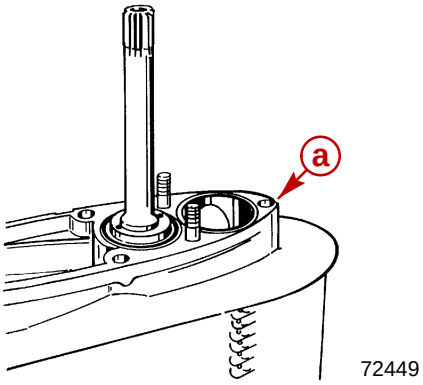
Speedometer Water Tube Pickup Inspection and Cleaning

1. Inspect opening (pitot tube), on leading edge of gear housing, for obstruction. Clean opening with a short piece of wire, if necessary. If obstruction cannot be removed with wire, carefully reopen tube using a 5/64 in. (2 mm) diameter drill bit. Do not drill beyond a depth of 2-7/16 in. (62 mm).



a - Opening (Pitot Tube)

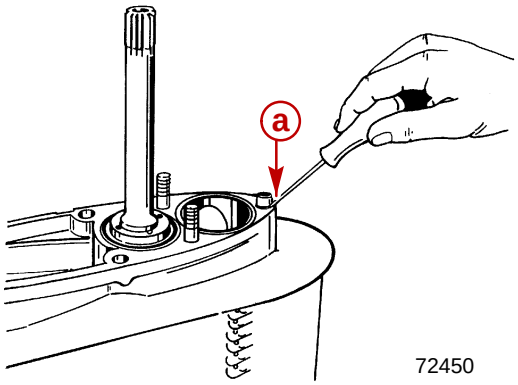
2. Inspect water tube seal for nicks, cuts or distortion. Replace if necessary.



a - Water Tube Seal

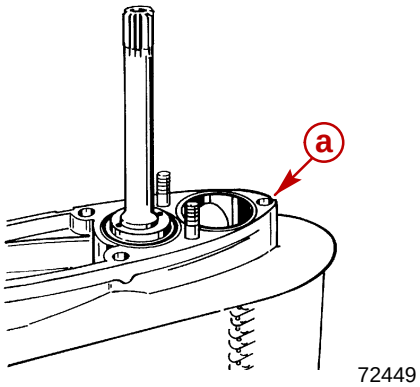
Speedometer Water Tube Seal Replacement

1. Pry water tube seal out with a suitable tool.



a - Water Tube Seal

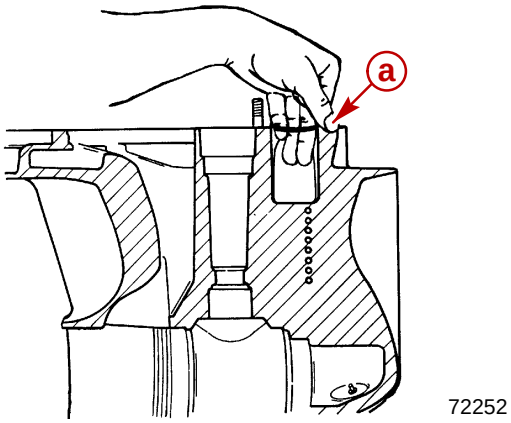
2. Lightly coat O.D. of seal with 3-M Adhesive and install in speedometer water tube bore. Ensure top edge of seal is flush with gear housing surface.



a - Seal – Seat Flush with Edge of Water Tube Bore

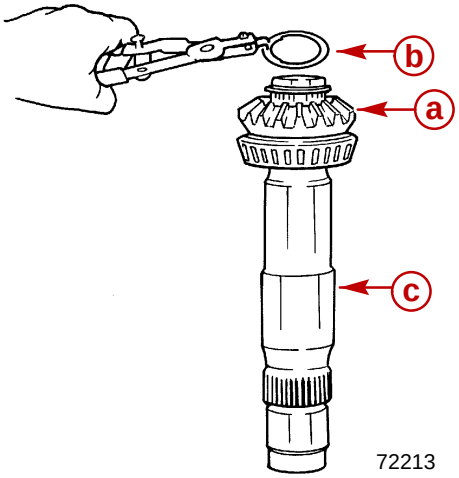
Gear Housing Reassembly and Shimming

1. Lubricate all gears and bearings with Quicksilver High Performance Gear Lube before installing. Components must be lubricated to obtain accurate bearing preload readings.
2. Install water passage O-ring and oil passage quad ring. Hold in place using 3-M Adhesive.



a - Water Passage O-Ring

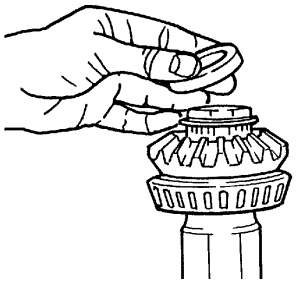
3. Install driven gear and bearing assembly, and snap ring to outer propeller shaft.

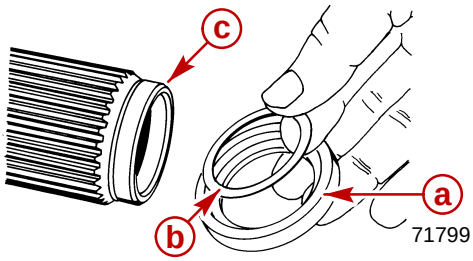


a - Driven Gear and Bearing Assembly
b - Snap Ring
c - Outer Propeller Shaft

NOTE: *The shim installed in the following step is used to regulate prop-shaft end-play. Use the existing shim as a starting point ONLY if shafts, gears, or bearings <u>were not</u> replaced. If any of the components were replaced, use a .020 in. shim as a starting point. This shim may need to be adjusted if the end-play is not within specifications (See "Checking Propeller Shaft End-Play" later in this section).*

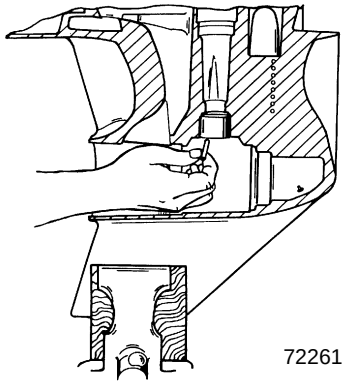
4. Apply a light coat of Loctite 242 to inside diameter of thrust cap. Be careful not to get Loctite on shim mating surfaces. Install thrust cap and appropriate size shim on outer propeller shaft. Ensure cap is straight while pressing into place.



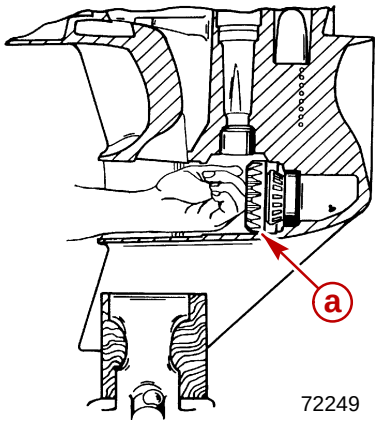


a - Thrust Cap
b - Shim
c - Outer Propeller Shaft

5. Make certain that all needle bearings are installed into lower needle bearing casing. Use Needle Bearing Assembly Lubricant to hold needle bearings in place.

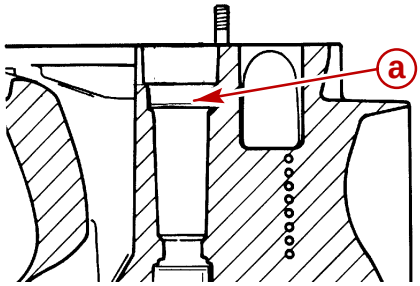


6. Install front driven gear assembly into gear housing.



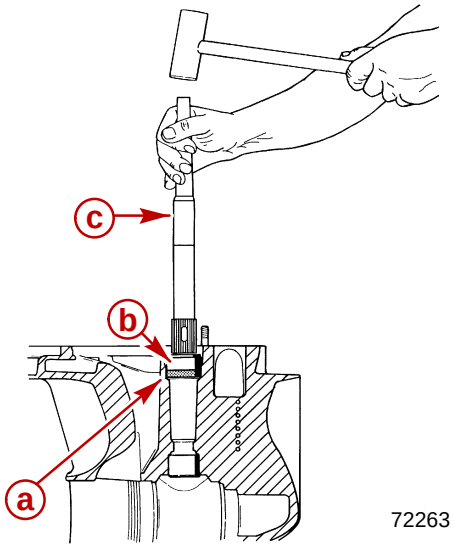
a - Front Driven Gear Assembly

7. Install original shim(s) into gear housing. If shims were lost or ruined where original thickness cannot be determined, install a .050 in. (1.27 mm) shim pack for a starting point.



a - Shim(s)

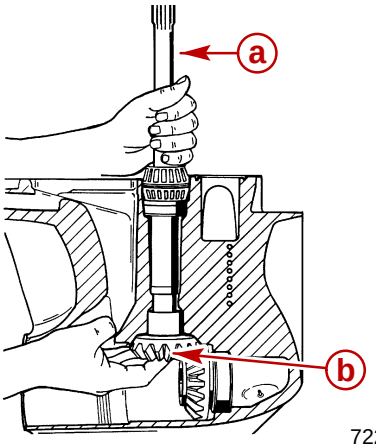
8. Install drive shaft lower bearing cup, using cup driver.



a - Bearing Cup
b - Bearing Cup Driver (P/N 91-67443)
c - Old Propeller Shaft or Driver Rod

9. Install drive shaft and pinion gear into gear housing.

NOTE: *Be careful not to lose rollers from drive shaft pinion bearing should they drop during drive shaft installation.*

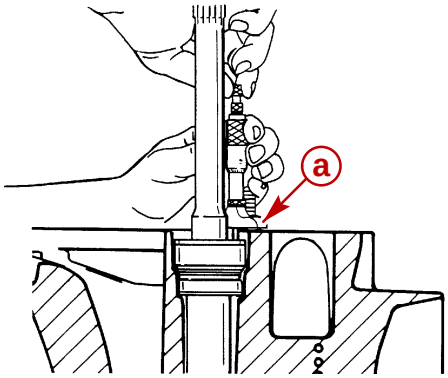


72264

a - Drive Shaft
b - Drive Shaft Pinion Gear

10. Determine shim thickness required for drive shaft bearing preload.

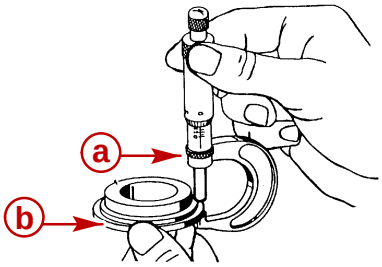
a. Install upper bearing cup and tab washer. Measure distance between top of gear housing and tab washer.



72452

a - 0 to 1 Inch Depth Micrometer

b. Measure thickness of spacer from top machined surface to bottom machined surface.



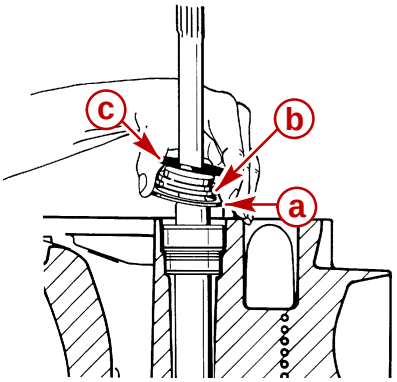
72523

a - Outside Micrometer
b - Spacer

c. Calculate shim thickness as shown.
Measurement from Step “a” minus (-)
Measurement from Step “b” plus (+)
.001 In. (0.025 mm) equals (=)
Shim Thickness Required.

index

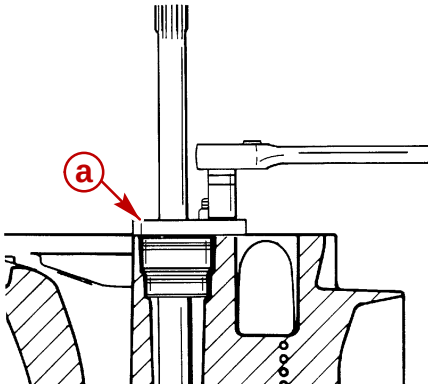
11. Install shims, spacer and new O-ring.



72451

a - Shim(s)
b - Spacer
c - O-Ring

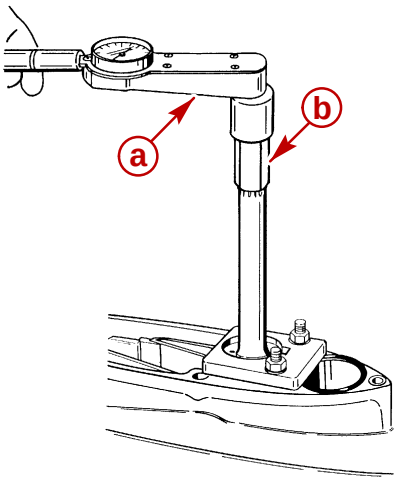
12. Reinstall clamping plate on gear housing. Tighten securely.



72266

a - Clamp Plate (P/N 91-43559)

13. Using a dial-type lb. in. torque wrench, check the rolling preload [3-5 lb. in. (0.3-.6 N·m)]. If necessary, add or subtract shims from beneath spacer to bring the preload into the specified range.

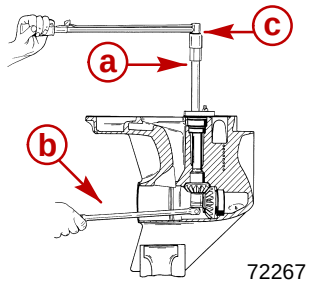


72269

a - Dial-Type Lb. In. Torque Wrench
b - Drive Shaft Adaptor (P/N 91-61077)

14. Ensure clamp plate has been reinstalled after adjusting preload in the previous step. It must be in place for checking pinion height in the following procedure.

15. Temporarily install drive shaft pinion gear retaining bolt and washer. Torque bolt to 35 lb. ft. (47.5 N·m).

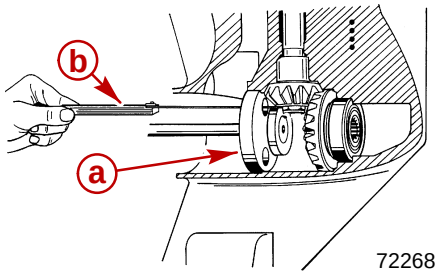


a - Drive Shaft Adaptor Tool (P/N 91-61077)
b - Breaker Bar and Socket
c - Torque Wrench and Socket

16. Check pinion height as follows:

    a. Insert shimming tool into gear housing.

    b. Measure clearance between tool and gear with feeler gauge. Clearance must be .023-.028 in. (0.575-0.700 mm). Take measurement at three locations on gear (120 degrees apart).



a - Shimming Tool (P/N 91-805462)
b - Feeler Gauge

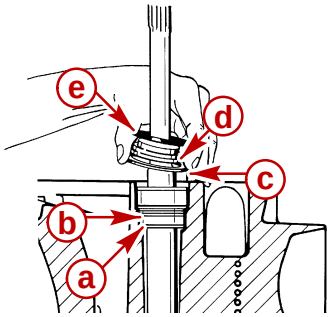
RATIO	DRIVE	DRIVEN	DRIVEN
Use Tool Position 16:27			
2.43:1	13	24	24
2.20:1	16	27	27
2.00:1	16	27	27
1.81:1	16	27	27
1.65:1	18	25	25
Use Tool Position 15:19			
1.50:1	15	19	19
1.36:1	15	19	19

If clearance is less than specified, add appropriate thickness of shims under lower tapered roller bearing cup.

Any thickness added here must be subtracted from shim thickness at upper bearing.

If clearance is more than specified, remove appropriate thickness of shims from under lower tapered roller bearing cup.

Any thickness subtracted here must be added to shim thickness at upper bearing.



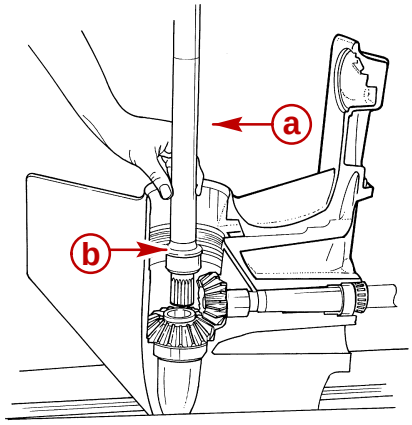
72451

a - Shims, Lower
b - Bearing Cup, Lower
c - Shims, Upper
d - Spacer
e - O-Ring

c. Recheck clearance after changing shim(s) (Step “b” above).

Checking Backlash

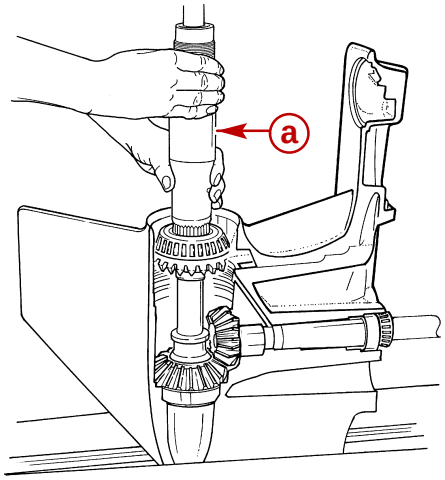
1. Install inner propeller shaft and thrust bearing into gear housing.



72270

a - Inner Propeller Shaft
b - Thrust Bearing

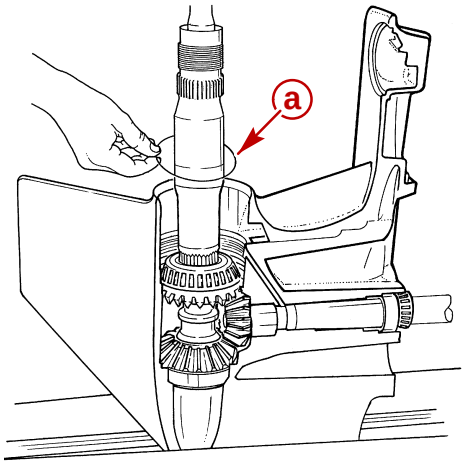
2. Fill area between outer propeller shaft seals with Quicksilver Special Lubricant 101 and install outer propeller shaft into gear housing.



72271

a - Outer Propeller Shaft

3. Install new shim pack of the same thickness as removed into gear housing. If shims were lost or ruined where original thickness cannot be determined, install a .050 in. (1.3 mm) shim pack for a starting point.

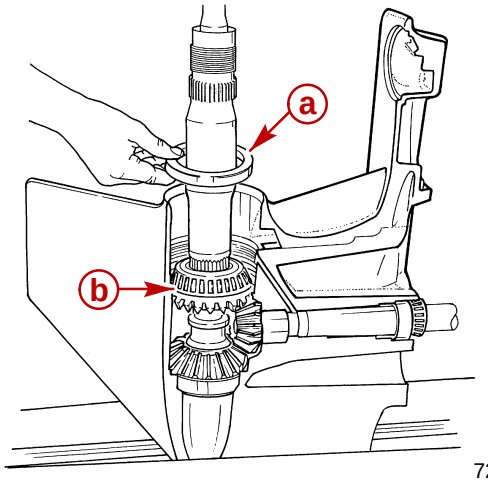


72272

a - Shim Pack

index

4. Install bearing cup into gear housing. Seat bearing cup against shim pack.



72273

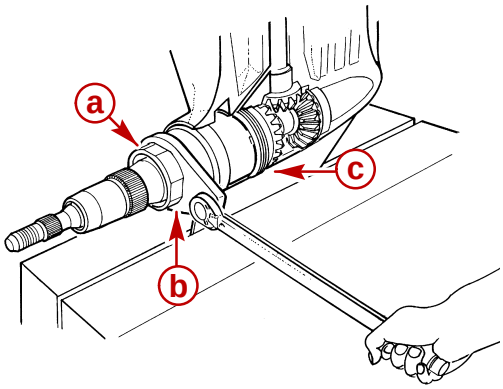
a - Bearing Cup
b - Shim Pack

⚠ CAUTION

Outer propeller shaft bearing retainer has a LEFT- HAND THREAD. Install by turning COUNTERCLOCKWISE.

IMPORTANT: Bearing carrier and threads on outer propeller shaft bearing retainer (nut) must be lubricated to prevent corrosion and cracking in gear housing.

5. Install outer propeller shaft bearing retainer, by turning counterclockwise, using outer propeller shaft bearing retainer installation tools. Torque to 200 lb. ft. (271 N·m).



72274

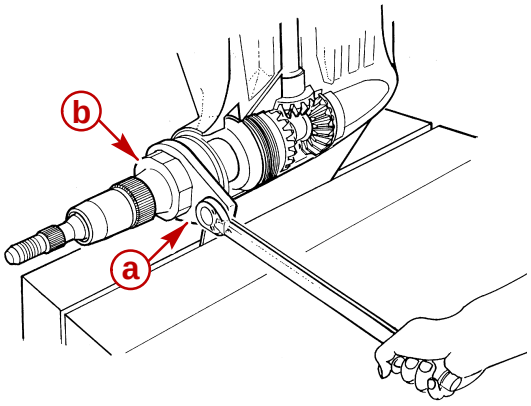
a - Bearing Retainer Installation Tool (P/N 91-805382)
b - Bearing Carrier Tool (P/N 91-805374)
c - Bearing Retainer

6. Apply Quicksilver Special Lubricant 101 to threads and O-ring surface area of bearing carrier and install O-ring on bearing carrier. Fill area between seals with same lubricant. Apply Quicksilver Perfect Seal to tapered surface of bearing carrier that comes in contact with housing.

⚠ CAUTION

Bearing carrier has a LEFT-HAND THREAD. Install by turning COUNTERCLOCKWISE.

7. Install bearing carrier, by turning counterclockwise, using bearing carrier installation tool. Torque to 150 lb. ft. (203 N·m).

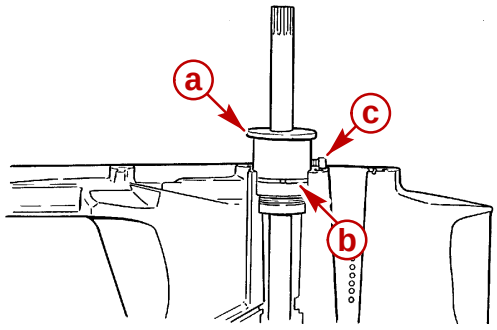


72275

a - Bearing Carrier Installation Tool (P/N 91-805374)
b - Bearing Carrier

8. Front driven gear shimming.

   a. Remove clamp plate, O-ring, spacer and shim(s), and place drive shaft retaining tool on tab washer as shown. Do not tighten locking bolt at this time.



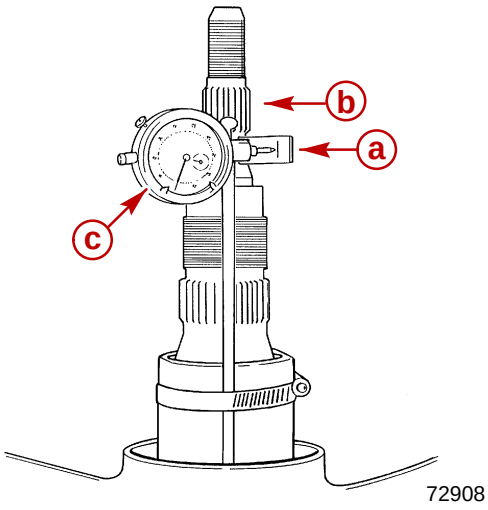
72623

a - Drive Shaft Retaining Tool (P/N 91-805381)
b - Tab Washer
c - Locking Bolt

   b. Position gear housing so that propeller shafts are facing up in the vertical position. Rotate propeller shafts several times to seat bearings prior to making checks.

   c. Lightly press down on drive shaft retaining tool, while simultaneously turning shaft, to ensure bearings are seated in bearing cups, then tighten locking bolt to retain drive shaft.

d. Install backlash indicator rod to inner propeller shaft as shown. Mount dial indicator to bearing carrier and position probe on mark stamped in indicator rod.



a - Backlash Indicator Rod
b - Inner Propeller Shaft
c - Dial Indicator

e. Check total gear/spline backlash by lightly rotating inner propeller shaft back and forth. Observe dial indicator and record reading.

f. From the Gear/Spline Lash reading checked earlier, subtract reading obtained from Propeller Shaft Spline Lash Check. Actual gear backlash should be between .012-.016 in. (0.3-0.4 mm).

Example:

Total Gear/Spline Backlash (Reading - Step 8d Above):	.030 In. (0.75 mm)
	Minus
Spline Lash (From Propeller Shaft Spline Lash Check on page 3D-22):	.016 In. (0.4 mm)
	Equals
Actual Gear Backlash:	.014 In. (0.35 mm)

g. If backlash is not correct, disassemble and proceed as follows:

If backlash is **more** than specified, **add** shims behind front driven gear bearing cup.

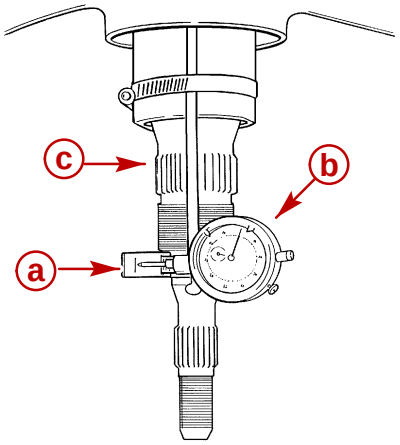
If backlash is **less** than specified, **remove** shims behind front driven gear bearing cup.

h. Recheck backlash reading after reassembly.

9. Rear driven gear shimming.

   a. Position gear housing so that propeller shafts are facing down in the vertical position. Loosen locking bolt on drive shaft retaining tool and rotate propeller shafts several times to seat bearings prior to making checks. Lightly press down on drive shaft retaining tool to ensure bearings are seated in bearing cups, then tighten locking bolt to retain drive shaft.

   b. Install backlash indicator rod to outer propeller shaft as shown. Mount dial indicator to bearing carrier and position probe on mark stamped in indicator rod.



75907

a - Backlash Indicator Rod
b - Outer Propeller Shaft
c - Dial Indicator

   c. Check gear/spline lash by lightly rotating outer propeller shaft back and forth. Observe dial indicator and record reading.

   d. From the Gear/Spline Lash reading checked earlier, subtract reading obtained from Propeller Shaft Spline Lash Check. Actual gear backlash should be between .012-.016 in. (0.3-0.4 mm).

Example:

Total Gear/Spline Backlash (Reading - Step 9c Above):	.030 in. (0.75 mm)
	Minus
Spline Lash (from Propeller Shaft Spline Lash Check from page 3D-22):	.016 in. (0.4 mm)
	Equals
Actual Gear Backlash:	.014 in. (0.35 mm)

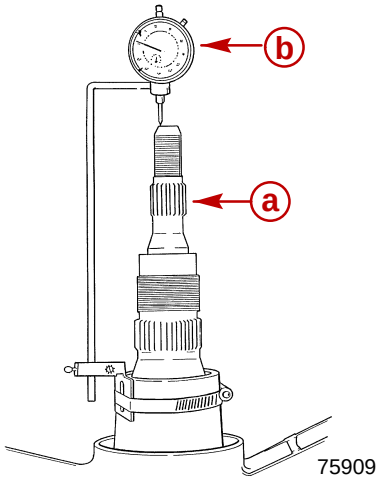
   e. If backlash is not correct, disassemble and proceed as follows:

      If backlash is **more** than specified, **remove** shims in front of rear driven gear bearing cup.

      If backlash is **less** than specified, **add** shims in front of rear driven gear bearing cup.

   f. Recheck backlash reading after reassembly.

10. **Check propshaft end play.** Install dial indicator on propshaft as illustrated below. Move inner shaft up and down while reading dial indicator (ensure outer shaft is also being lifted by inner shaft). End play reading should be between .001-.050 in. (0.025-1.27 mm). If reading is outside of range, the outer propeller shaft thrust race shims must be increased or decreased to bring the end-play reading within this range (Refer to 3D-25).



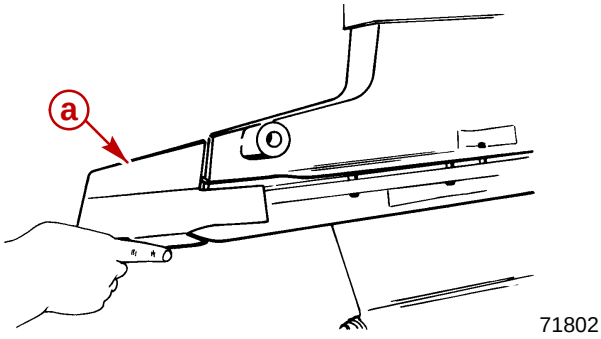
a - Inner Propeller Shaft
b - Dial Indicator

11. Remove drive shaft retaining tool and reinstall shim(s), spacer and O-ring.

Installing Gear Housing On Drive Shaft Housing

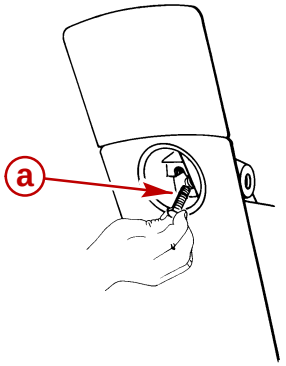
NOTE: *Later style Bravo Three drive units have the splash plate extension incorporated into the gear housing.*

1. Install gear housing to drive shaft housing as follows:
   a. Lower upper drive shaft housing down onto gear housing. **If Applicable** - Slide the splash plate extension between the slot in the drive shaft housing.



a - Splash Plate Extension

   b. Install bolt in anode cavity. Torque to 35 lb. ft. (47 N·m).

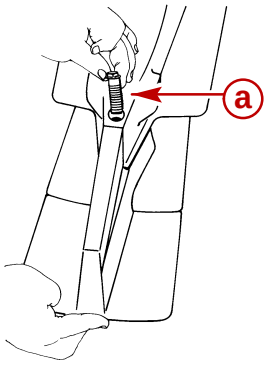


71805

a - Bolt

NOTE: *Earlier Bravo Three drive units were equipped with two anodic plates. The rear anode is attached with a bolt from the bottom side of the splash plate.*

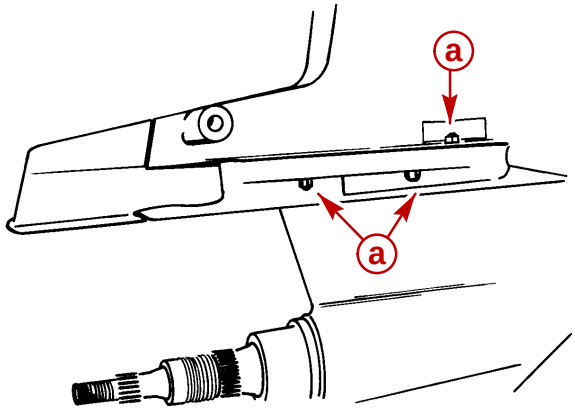
c. Install anode(s) and torque to 23 lb. ft. (32 N·m). Install plastic plug.



71804

a - Bolt

d. Secure drive shaft housing to gear housing with 6 locknuts and flat washers.



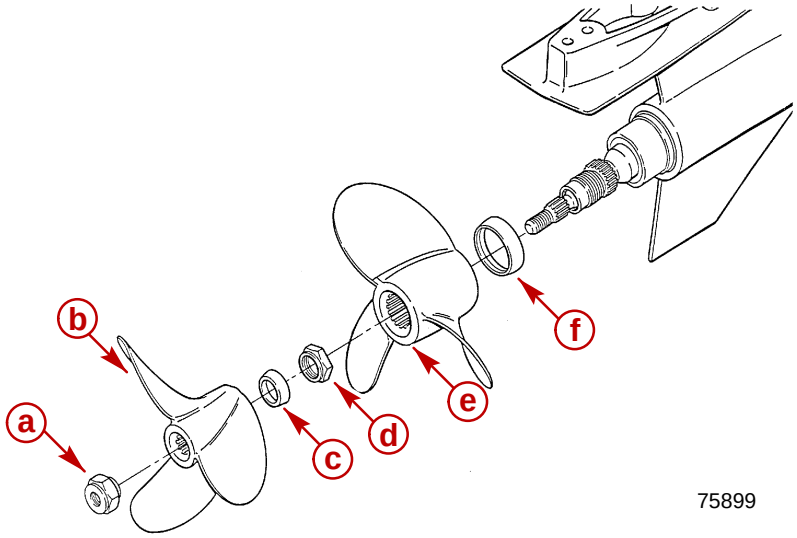
71803

a - Locknuts and Flatwashers (6)

2. Reinstall drive unit. Refer to Section 2A.
3. Fill drive unit with gear lube. Refer to Section 1B.

Propeller Installation

1. Apply a liberal coat of one of the following Quicksilver lubricants to both the inner and outer propeller shafts: Special Lubricant 101, 2-4-C Marine Lubricant with Teflon, or Anti-Corrosion Grease.



a - Rear Propeller Nut
b - Rear Propeller
c - Rear Propeller Thrust Hub
d - Front Propeller Nut
e - Front Propeller
f - Front Propeller Thrust Hub

2. Slide the front thrust hub onto the outer propeller shaft with the tappered side of the hub toward the aft end of the propeller shaft.
3. Align the splines and place the forward propeller onto the outer propeller shaft.
4. Install the front propeller nut and torque to at least 100 lb. ft. (136 N·m). Check propeller tightness after 20 hours of operation. DO NOT operate the boat with a loose propeller.
5. Slide the rear thrust hub onto the inner propeller shaft with the tappered side of the hub toward the aft end of the propeller shaft.
6. Align the splines and place the rear propeller onto the inner propeller shaft.
7. Install the rear propeller nut and torque to at least 60 lb. ft. (81 N·m). Check propeller tightness after 20 hours of operation. DO NOT operate the boat with a loose propeller.

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TRANSOM ASSEMBLY

Section 4A - Service Procedures Requiring Minor Disassembly

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4 A

Bravo Transom Assembly Specifications

Torque Specifications

DESCRIPTION	TORQUE		
	lb. in.	lb. ft.	N·m
Shift Cable Core Wire Anchor Screws	20		2.3
Bellows Hose Clamps	35		4
Hinge Pins		150	203
Through Bolt Lock Nut		25	34
Pivot Bolt		23	30
U-bolt Nuts		40	54
Bellows Clamps		35	47
Sterndrive Attaching Nut		23	30
90° Hose-Barb Compression Fitting	80		9
90° Fitting Nut		12	16

Lubricants/Sealers/Adhesives

DESCRIPTION	PART NUMBER
3M Brand Adhesive	92-86166-1
Liquid Neoprene	92-25711-2
Resiweld Sealer	92-65150-1
Loctite 27131	92-809820
Quicksilver 2-4-C Marine Lubricant with Teflon	92-825407A12

Special Tools

DESCRIPTION	PART NUMBER
Bearing Removal and Installation Tool	91-31229A7
Bellows Expander Tool	91-45497A1
Slide Hammer Puller	91-34569A1
Tapered Insert Tool	91-43579
Core Wire Locating Tool	91-17263
Shift Cable Anchor Adjustment Tool	91-17262
Sleeve Removal Tool (U-joint Bellows)	91-818169
Sleeve Installation Tool (U-joint Bellows)	91-818162

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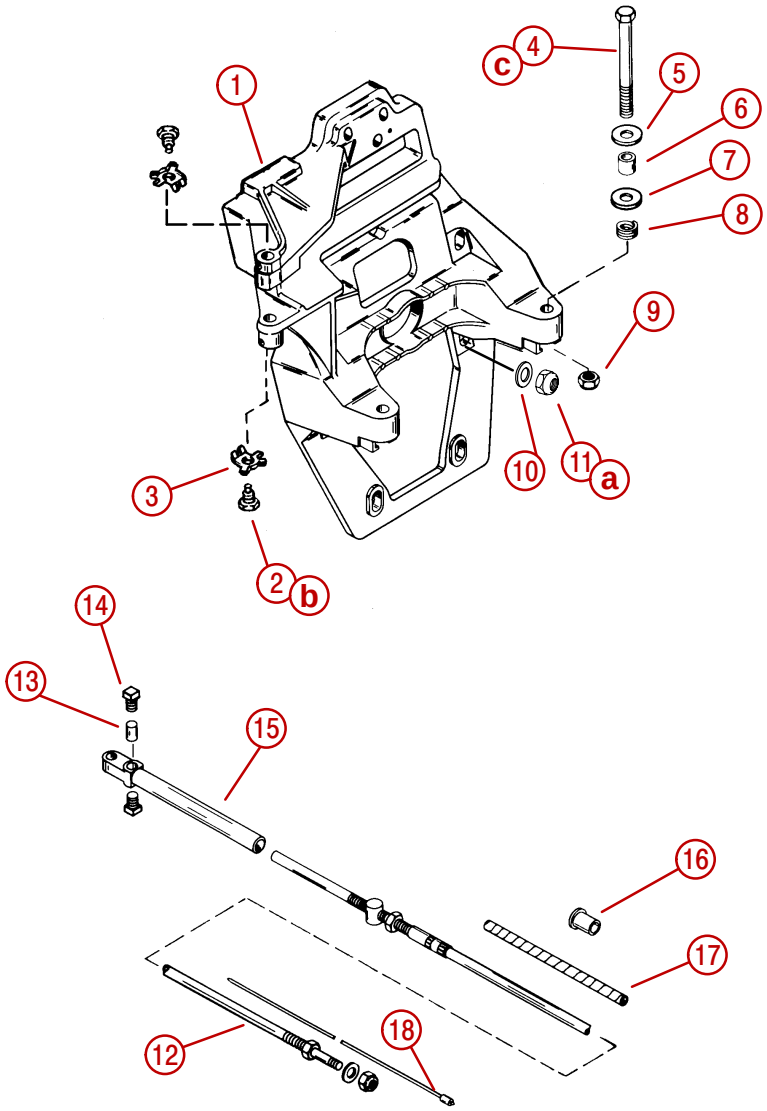
Bravo Transom Assembly Exploded Views

Inner Transom Plate Components



74850

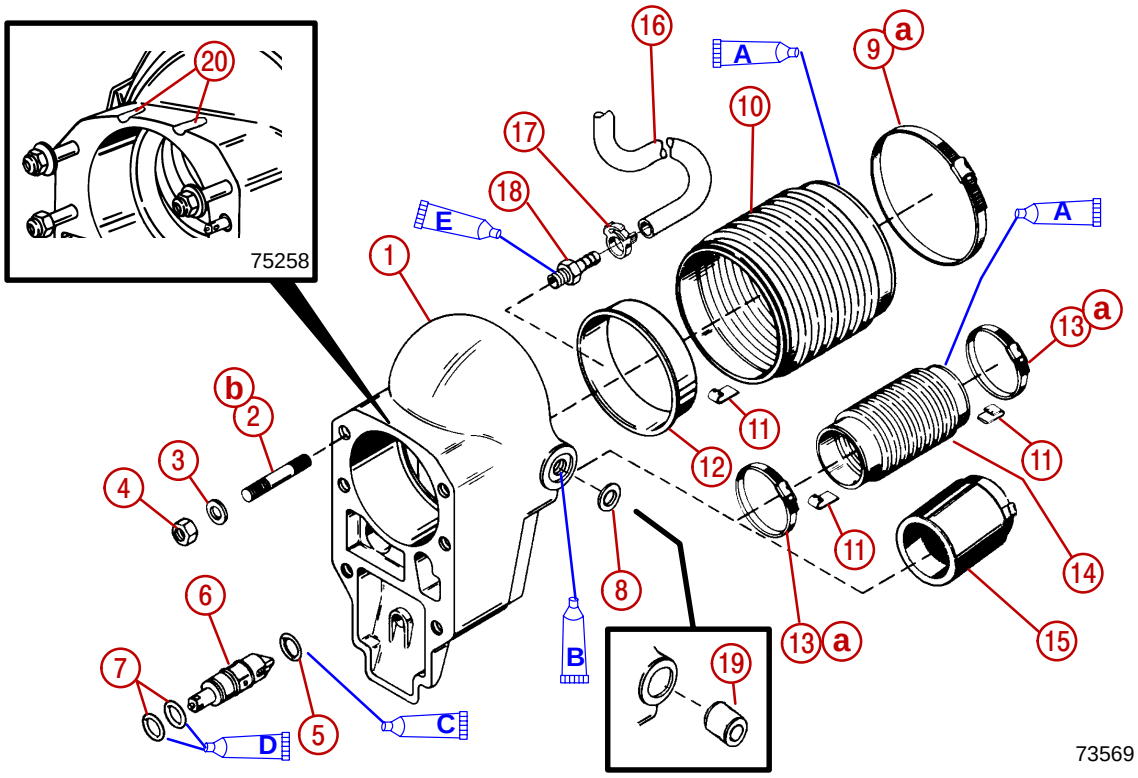
1 - Transom Plate Assembly
2 - Pivot Bolts
3 - Tab Washers
4 - Screw Engine Mounting
5 - Washer
6 - Spacer
7 - Washer - Fiber
8 - Lockwasher - Double Wound
9 - Locknut
10- Washer
11- Locknut
12- Shift Cable Casing
13- Core Wire Anchor
14- Anchor Screws (2)
15- End Guide
16- Pilot Bushing - Gimbal Housing
17- Wrapping
18- Core Wire

Torque Specifications

(a) 25 lb. ft. (34 N·m)
(b) 23 lb. ft. (30 N·m)
(c) 37 lb. ft. (50 N·m)

Index

Bell Housing Components



1 - Bell Housing
2 - Stud
3 - Washer
4 - Locknut
5 - O-ring
6 - Gear Lube Valve
7 - O-rings
8 - Hinge Pin Washer
9 - Bellows Clamp
10- U-Joint Bellows
11- Grounding Clip
12- Sleeve
13- Bellows Clamp
14- Exhaust Bellows
15- Exhaust Tube (Some Models)
16- Water Hose
17- Hose Clamp
18- Water Fitting
19- Bushing (High Performance Transom)
20- Indentations in Later Style Bell Housing (Must Be Used With Trim-In Limit Pins)

Lubricants, Sealers, and Adhesives

A - 3M Brand Adhesive 92-86166-1

B - Loctite 27131 92-809820

C - 3M Brand Adhesive 92-86166-1

D - Quicksilver High Performance Gear Lube 92-816026A4

E - Quicksilver Perfect Seal 92-34227-1

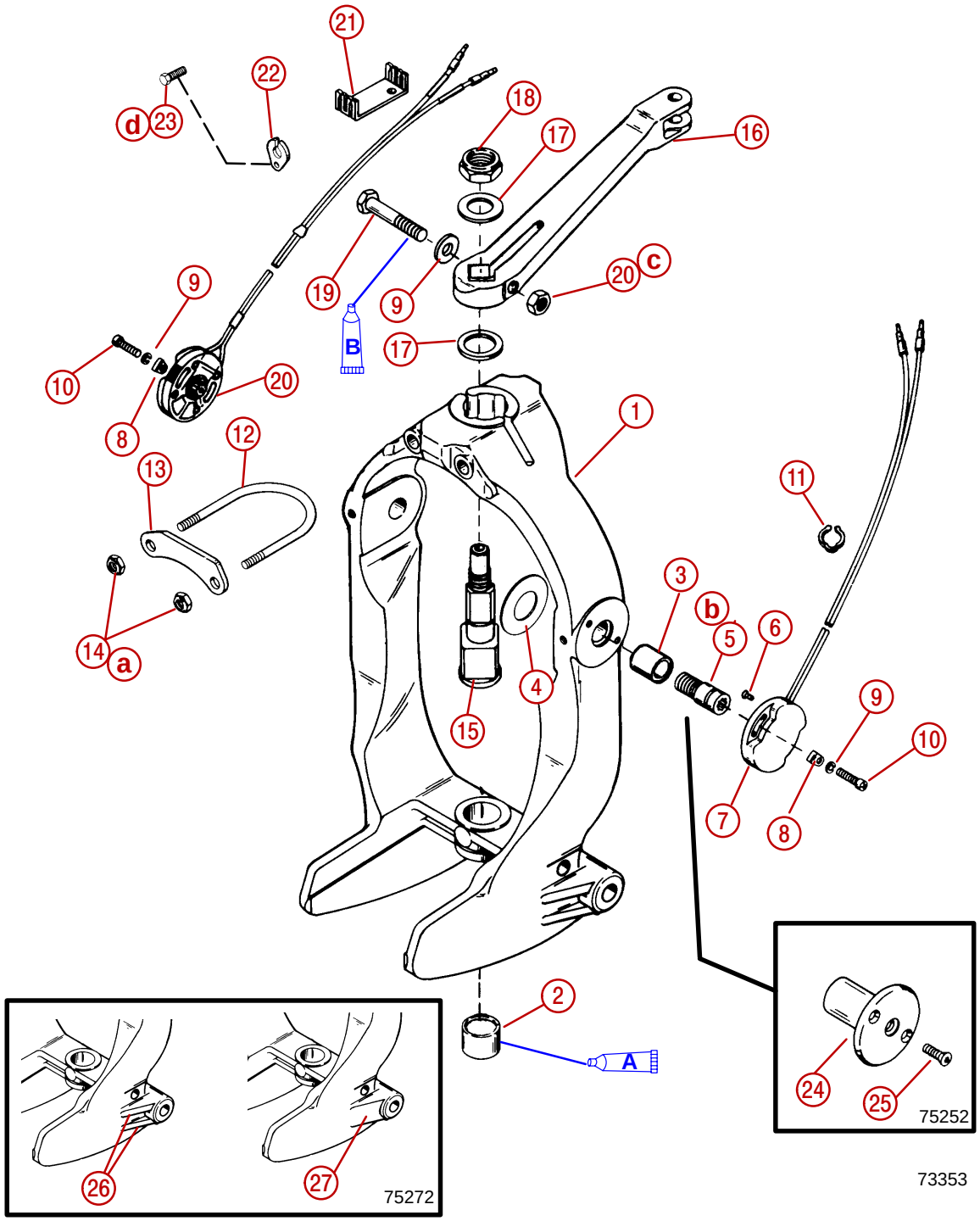
Torque Specifications

a Tighten Securely - Approximately 35 lb. in. (4 N·m)

b 50 lb. ft. (68 N·m)

Index

Gimbal Ring Components



1 - Gimbal Ring	15- Swivel Shaft
2 - Bushing	16- Steering Lever
3 - Bushing	17- Washer (Smaller I.D.)
4 - Washer	18- Washer (Larger I.D.)
5 - Hinge Pin	19- Clamp Screw
6 - Screw	20- Nut
7 - Trim Position Sender	21- Wire Retainer
8 - Clip	22- Trim Wire Clamp
9 - Washer	23- Screw
10- Screw	24- Hinge Pin (High Performance Transom Only)
11- Clip	25- Screws (High Performance Transom Only)
12- U-Bolt	26- Standard Gimbal Ring Identification. (Two Ribs)
13- Plate	27- Magnum and High Performance Gimbal Ring Identification. (Filled Area)
14- Locknuts	

Lubricants, Sealers, and Adhesives

A - Resiweld Sealer 92-65150-1

B - Quicksilver 2-4-C Marine Lubricant with Teflon 92-825407A12

Torque Specifications

(a) 50-55 lb. ft. (67-74 N·m)

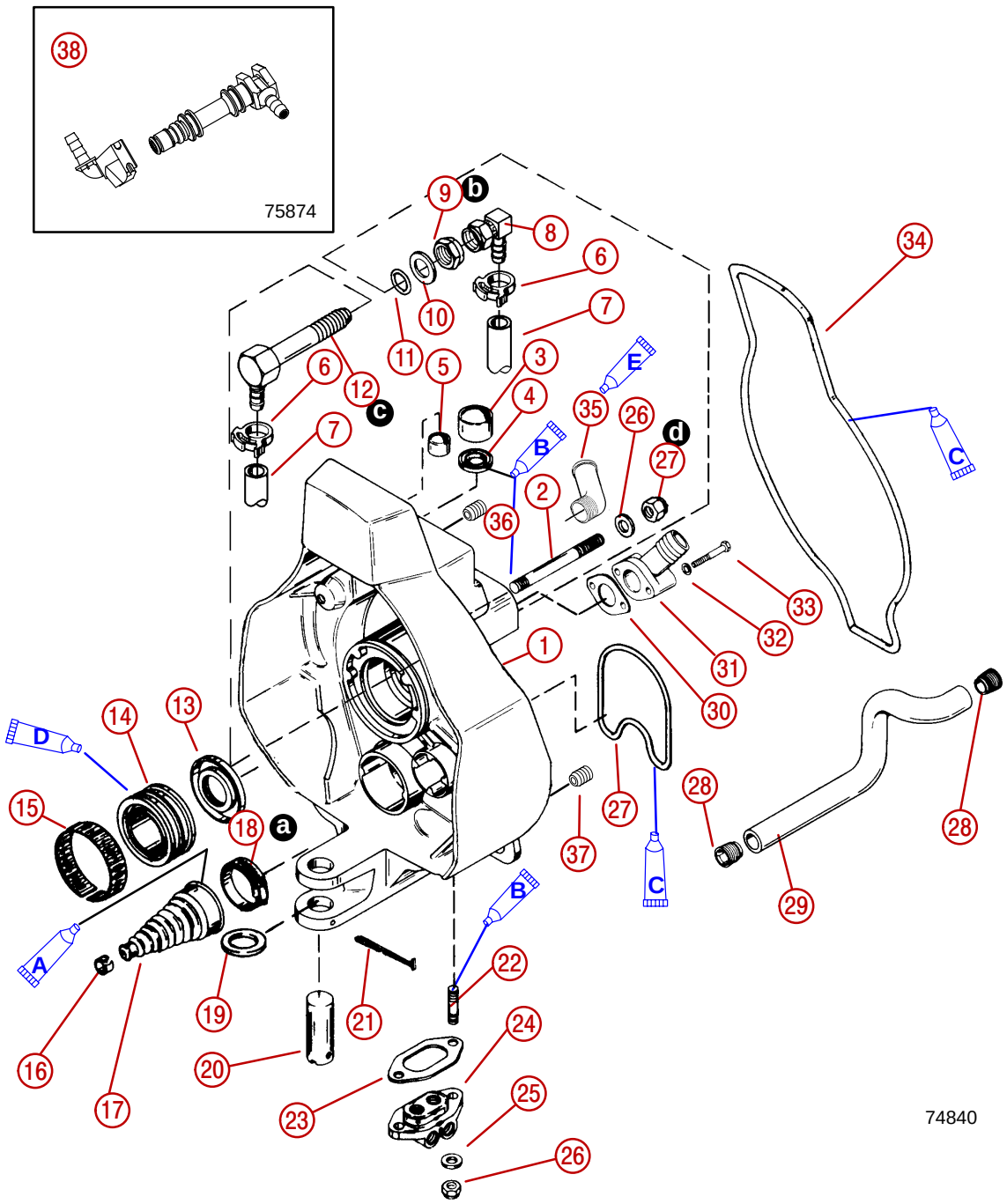
(b) 150 lb. ft. (203 N·m)

(c) 45-55 lb. ft. (61-74 N·m)

(d) 90-100 lb. in. (10-11 N·m)

Index

Gimbal Housing Components



1 - Gimbal Housing
2 - Stud
3 - Lower Bushing
4 - Seal
5 - Upper Bushing
6 - Clamp
7 - Gear Lube Hose
8 - Swivel Fitting
9 - Locknut
10- Washer
11- O-ring
12- Gear Lube Fitting
13- Seal
14- Gimbal Bearing
15- Tolerance Ring
16- Crimp Clamp
17- Shift Cable Bellows
18- Bellows Clamp
19- Washer
20- Lower Swivel Pin
21- Cotter Pin
22- Stud
23- Gasket
24- Hydraulic Manifold
25- Lockwasher
26- Locknut
27- Exhaust Passage O-ring
28- Water Hose Insert
29- Water Hose
30- Water Fitting Gasket
31- Water Fitting
32- Lockwasher
33- Screw
34- Gimbal Housing Seal
35- Water Bypass Fitting (Some Diesel Models)
36- Pipe Plug (or Speedometer Fitting - Later Style)
37- Pipe Plug (or Speedometer Fitting - Earlier Style)
38- Bulkhead Fitting

Lubricants/Sealers/Adhesives

A - Loctite 27131 92-809820

B - 3M Brand Adhesive 92-86166-1

C - Quicksilver U-Joint and Gimbal Bearing Grease 92-828052A2

D - Super Glue . . . . . Obtain Locally

E - Perfect Seal 92-34227-1

Torque Specifications

(a) Tighten Securely -Approximately 35 lb. in. (4 N·m)

(b) 12 lb. ft. (16 N·m)

(c) 80 lb. in. (9 N·m)

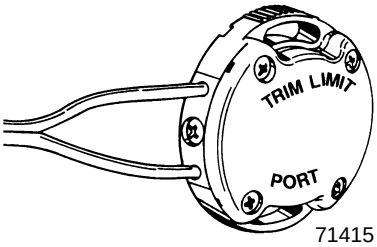
(d) 25 lb. ft. (34 N·m)

Index

Special Information

Trim Limit Switch

The trim limit switch has a sealing system for improved water resistance and durability. The trim limit switch leads are connected internally to help ensure good electrical integrity.

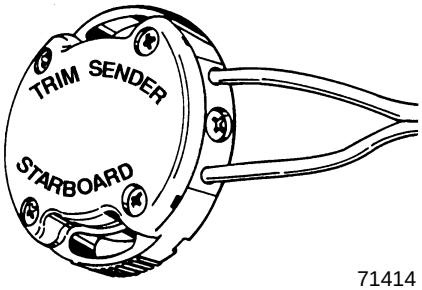


71415

Trim Limit Switch - Port

Trim Position Sender

The trim position sender has a sealing system for improved water resistance and durability. The trim limit leads are connected internally to help ensure good electrical integrity.



71414

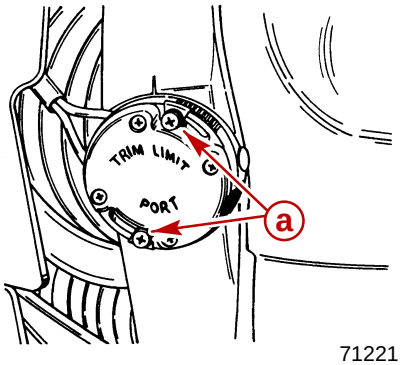
Trim Position Sender - Starboard

Removal

⚠ WARNING

Disconnect both battery cables before installing new trim limit switch or trim sender.

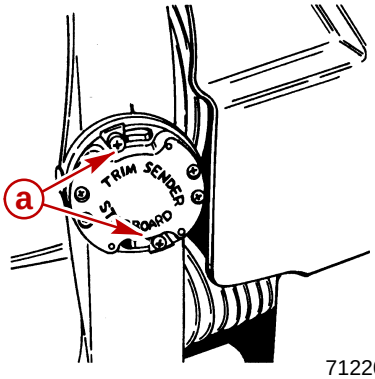
1. Remove sterndrive unit.
2. Remove trim limit switch.



71221

a - Screws, Washers, and Retainers

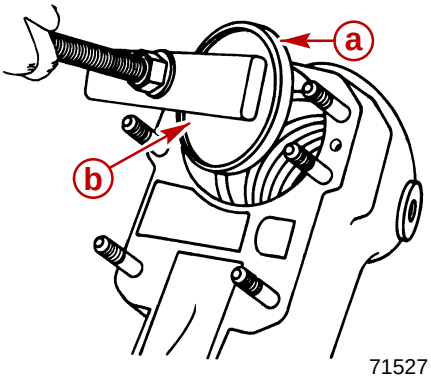
3. Remove trim position sender.



71220

a - Screws, Washers, and Retainers

4. Remove U-joint bellows sleeve.

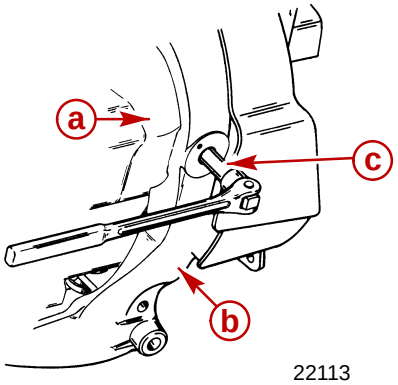


71527

a - Sleeve
b - Removal Tool (P/N 91-818169)

Index

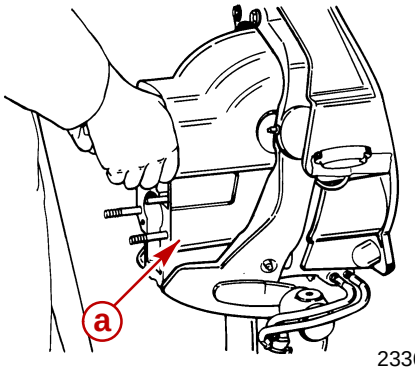
5. Remove both hinge pins.



22113

a - Bell Housing
b - Gimbal Ring
c - Hinge Pin Tool (P/N 91-78310)

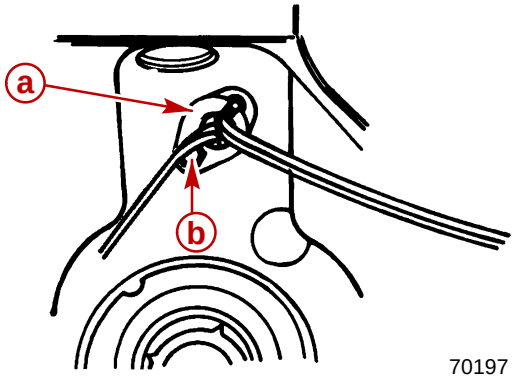
6. Pull back on bell housing and rotate it 90 degrees to gain access to the trim wire retainer screw.



23363

a - Bell Housing

7. Remove trim wire retainer.



70197

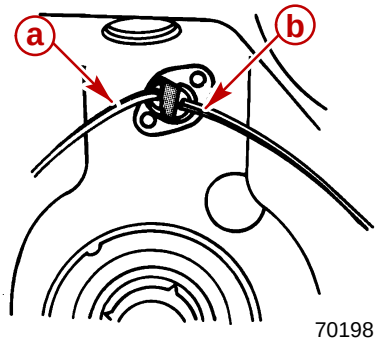
a - Clamp
b - Screw

8. Disconnect trim position sender wires from engine harness.

Installation

NOTE: *If desired, old harness may be used to pilot new harnesses through hole in gimbal housing.*

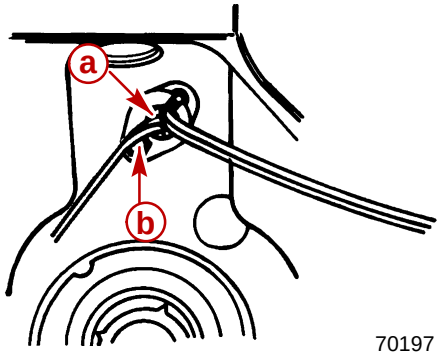
1. Route new sender wires through hole. Bring together the two grommet halves and ensure they are seated lightly in the hole and that the flat edges that mate together are vertically aligned. Maintain light tension off the wires from inside the boat, to hold the grommets in the hole.



70198

a - Trim Limit Switch Wires
b - Trim Position Sender Wires

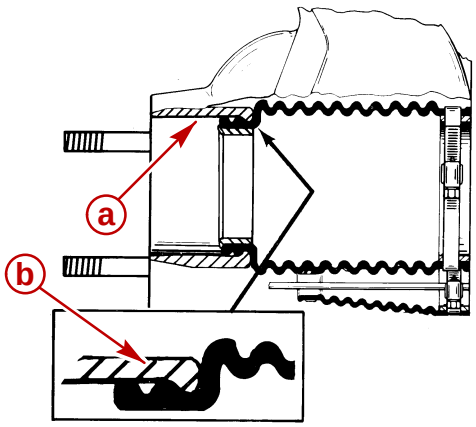
2. Reinstall retainer and torque screw to 90-100 lb. in. (10.2-11.3 N·m).



70197

a - Clamp
b - Screw

3. Install U-joint bellows on bell housing as follows:
   a. Position U-joint bellows on bell housing. Ensure that the bell housing flange rests in the second groove from the end of bellows.

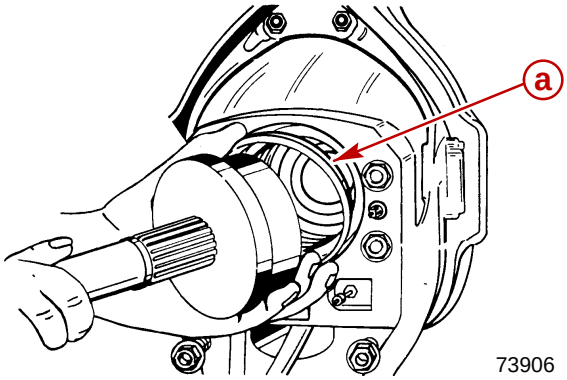


22116

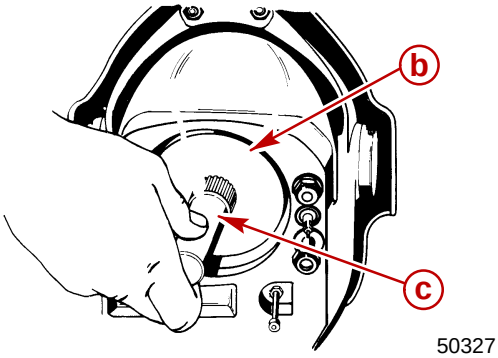
a - Bell Housing Flange

Index

b. Lubricate sleeve O.D. with soapy water or engine cleaner and install sleeve with sleeve installation tool and a suitable driving rod.



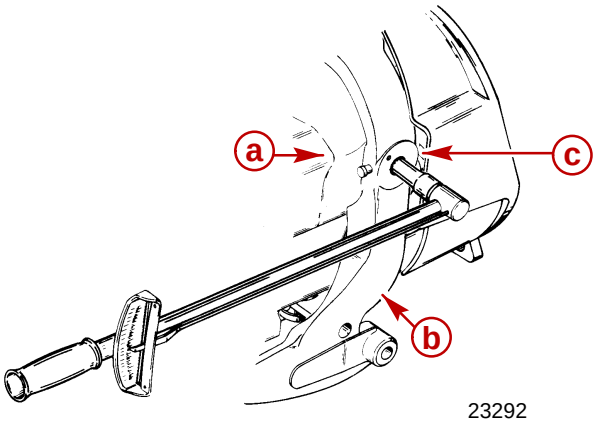
73906



50327

a - Sleeve
b - Sleeve Installation Tool (91-818162)
c - Suitable Driving Rod

4. Apply Locquic Primer “T” to internal bell housing threads and external hinge pin threads and allow to dry. Apply Loctite 27131 to bell housing threads and install hinge pins. Torque hinge pins to 140-150 lb. ft. (189-203 N·m).



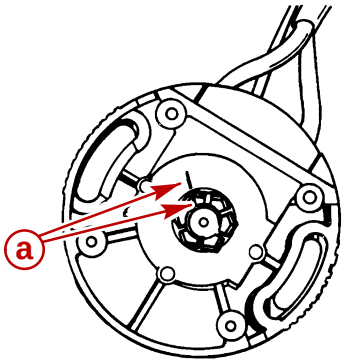
23292

a - Bell Housing
b - Gimbal Ring
c - Hinge Pin Tool (P/N 91-78310)

5. Install trim position sender as follows:

   a. Place sterndrive unit in the full DOWN/IN position.

   b. Turn center rotor of trim position sender to align index mark with index mark on sender body.

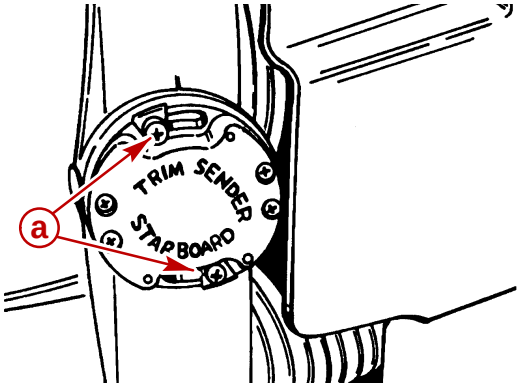


71218

a - Index Marks

Index

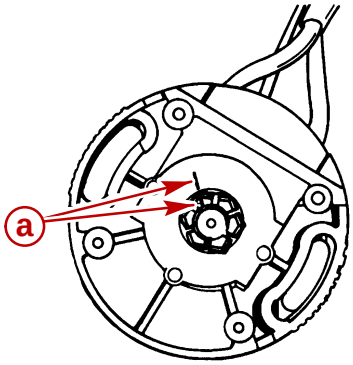
c. Install trim position sender and secure with attaching hardware.



71220

a - Screws, Washers, and Retainers

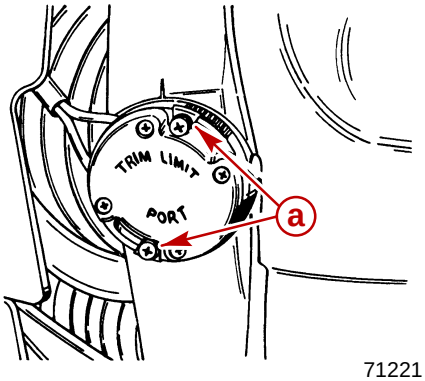
6. Tighten trim position sender retaining screws and recheck gauge reading.
7. Reinstall trim limit switch as follows:
   a. Place drive unit in full DOWN/IN position.
   b. Align index marks on switch.



71218

a - Index Marks

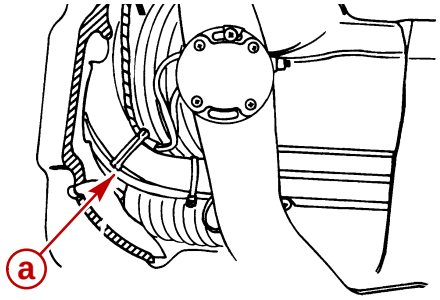
c. Install trim limit switch and secure with attaching hardware.



71221

a - Screws, Washers, and Retainers

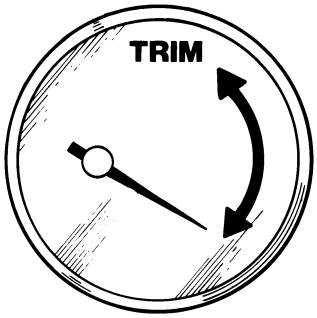
8. Secure the trim limit switch harness to the water hose with the plastic clip.



71184

a - Plastic Clip

9. Reconnect trim position sender wires to engine the harness and the trim leads to trim pump harness.
10. Reinstall battery cables.
11. Turn ignition key to the “RUN” position. DO NOT START ENGINE. Rotate sender until needle is at bottom of arc on gauge.



22175

Trim Limit Switch Adjustment

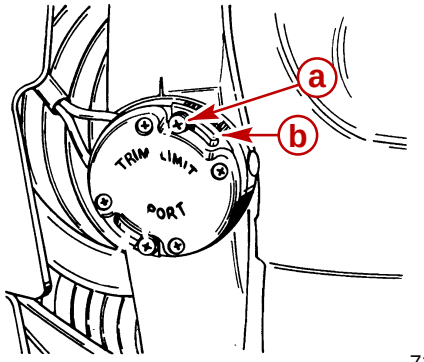
⚠ WARNING

When adjusting trim limit switch, use extreme care that engine is not started and keep clear of area near propeller. Use care to prevent placing hands in an area where injury could occur because of drive unit movement.

⚠ CAUTION

Trim limit switch MUST BE adjusted exactly as outlined. If switch is adjusted incorrectly, drive unit could move out beyond the gimbal ring support flanges and cause damage to sterndrive unit.

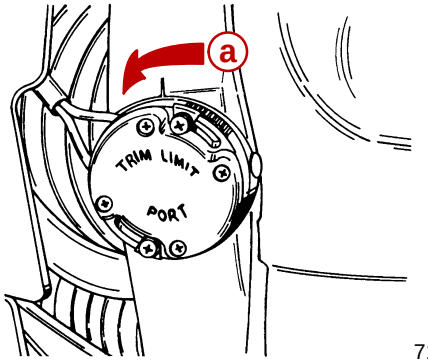
1. Adjust trim limit switch as follows:
   a. Loosen screws and turn trim limit switch clockwise to end of slots.



71221

a - Screws
b - Slots

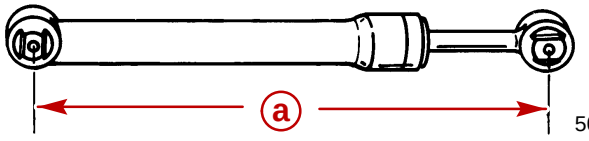
   b. Ensure drive unit is in the full DOWN/IN position.
   c. Trim drive unit UP/OUT. Do not use trailer switch.
   d. Slowly turn trim limit switch counterclockwise until trim cylinders extend to dimension shown (refer to appropriate illustration).



71221

a - Rotate Counterclockwise to Adjust

   e. Retighten screws when adjustment is correct.



50464

a - 21-3/4 in. (552mm) Maximum

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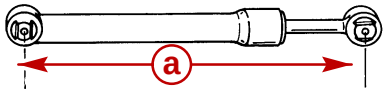
High Performance Transom Assembly - Without Electrical Trim Sender and Trim Limit Switch

IMPORTANT: The electrical Trim Limit Switch and Trim Position Sender are not present on this transom assembly. Without a Trim Limit Switch, the drive unit can be trimmed up/out beyond the position where the drive unit has side support from the gimbal ring at any throttle setting. It is highly recommended that a mechanical (cable actuated) Trim Position Indicator be installed to provide important drive unit trim angle information to the operator and that the Trim Indicator be marked to clearly indicate the maximum up/out position where side support is still provided. The drive unit should not be trimmed to a position beyond gimbal ring side support at engine speeds above 1200 RPM.

⚠ WARNING

Avoid personal injury or damage to sterndrive unit. Do not trim drive unit to an up/out position where the drive unit receives no side support from the gimbal ring at engine speeds above 1200 RPM. Refer to a properly marked mechanical Trim Position Indicator.

1. Install “WARNING DECAL” (Contained in the transom assembly box) at the operator station in a place where it will be clearly visible to the operator.
2. To mark the maximum “Trim Up/Out” position on the mechanical trim indicator, proceed as follows:
   a. Trim drive unit(s) to the “Full Down/In” position.
   b. Check to ensure that the mechanical trim indicator indicates “Full Down/In” position. Adjust the indicator following the manufacturers recommendations.
   c. Slowly raise the drive unit(s) until the trim limit point is reached. The trim limit point can be determined by measuring the amount of trim cylinder extension. The dimension for the Bravo and Blackhawk drive units is **21-3/4 in. (552 mm)**, which is measured from front anchor point to rear anchor point centerlines as shown following.



50464

a - Trim Limit Dimension 21-3/4 in. (552 mm)

   d. With the trim cylinders at this position, place a mark on the mechanical trim indicator.
   e. Raise and lower drive unit(s) several times to ensure that the trim limit point is properly marked.

Gimbal Bearing

IMPORTANT: Gimbal bearing and carrier are a matched set and must be replaced as an assembly. Tolerance ring must be replaced any time gimbal bearing is removed.

Inspection

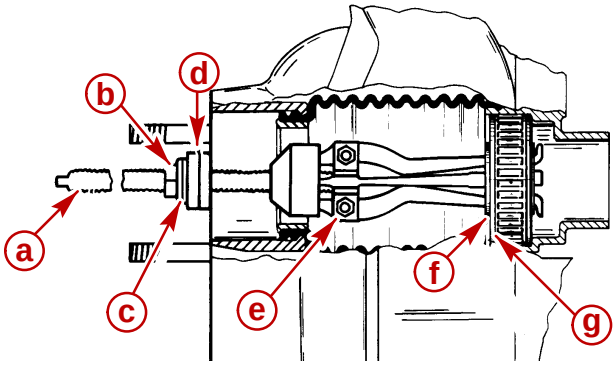
1. Remove sterndrive unit.
2. Reach through bell housing. Rotate gimbal bearing and check for rough spots. Pull and push on inner race to check for side wear. Any excessive movement or roughness is cause for replacement.

Removal

⚠ CAUTION

Do not remove gimbal bearing unless replacement is necessary, as damage to bearing may result during removal.

1. Remove gimbal bearing assembly.

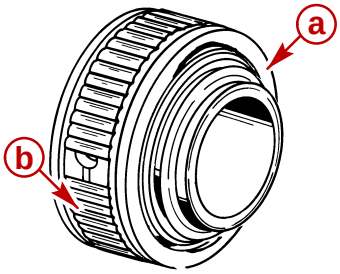


22119

a - *Puller Shaft 91-31229
b - *Nut 11-24156
c - *Washer 12-34961
d - 2 Plates 91-29310
e - Slide Hammer Puller
f - Gimbal Bearing Inner Race
g - Gimbal Bearing Carrier

* From Bearing Removal and Installation Tool 91-31229A7

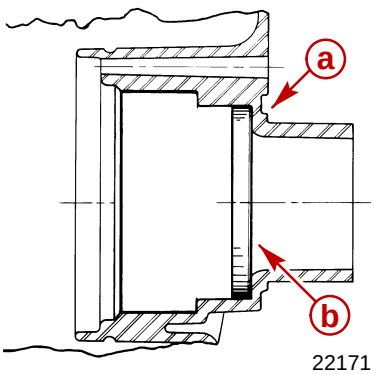
2. Remove tolerance ring.



22159

a - Gimbal Bearing Carrier
b - Tolerance Ring

3. Remove grease seal using a slide hammer.



22171

a - Gimbal Housing
b - Grease Seal

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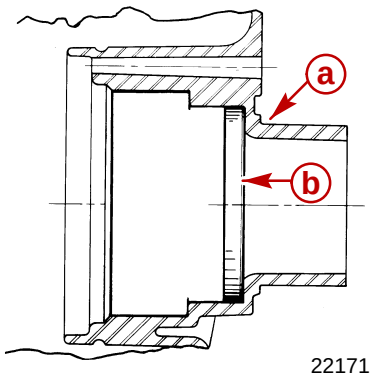
Installation

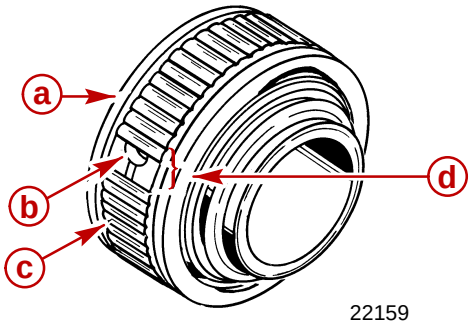
1. Install grease seal using a suitable mandrel.



22171

a - Gimbal Housing
b - Grease Seal

2. Install and position new tolerance ring, as shown.

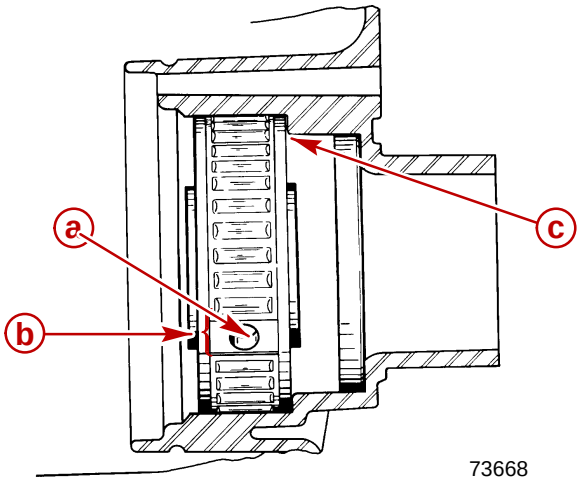


22159

a - Carrier
b - Carrier Grease Hole
c - Tolerance Ring
d - Align Opening in Tolerance Ring with Grease Hole in Carrier

IMPORTANT: Ensure that notched edge of bearing carrier faces inward in bore.

3. Align gimbal bearing carrier grease hole and tolerance ring opening with grease cavity hole in gimbal housing.



73668

a - Gimbal Bearing Carrier Grease Hole
b - Tolerance Ring Opening
c - Bearing Carrier Notch - Face Inward

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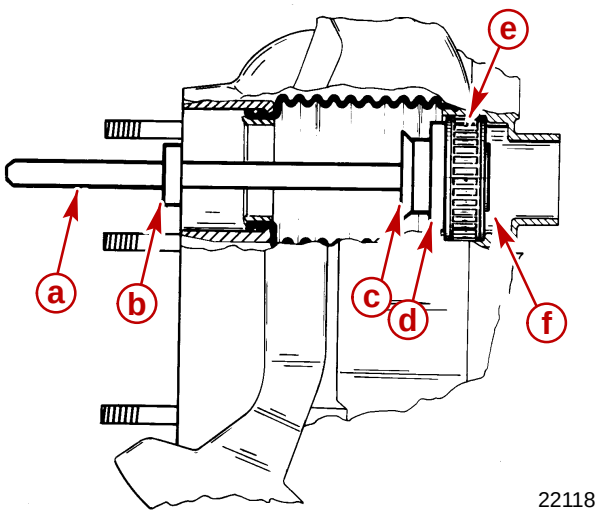
4. Install gimbal bearing, using a lead hammer and tools shown. Make sure that gimbal bearing carrier bottoms in gimbal housing.



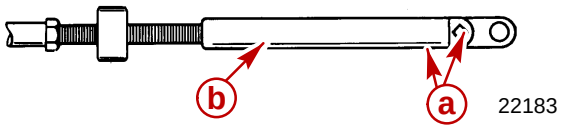
a - *Drive Rod 91-37323
b - *Plate 91-29310
c - *Drive Head 91-32325
d - *Mandrel 91-30366
e - Gimbal Bearing Assembly - Notches in Carrier Facing
Engine Coupler Bearing Carrier Beyond Chamfer in Gimbal Housing
f - Chamfer

* From Bearing Removal and Installation Tool 91-31229A7.

Shift Cable

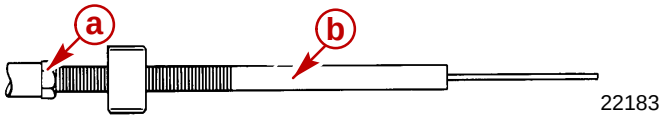
Removal

1. Remove sterndrive unit. Refer to Section 2A.
2. Disconnect shift cable from shift plate and remove end guide.



a - Anchor Screws (2) - Loosen
b - End Guide

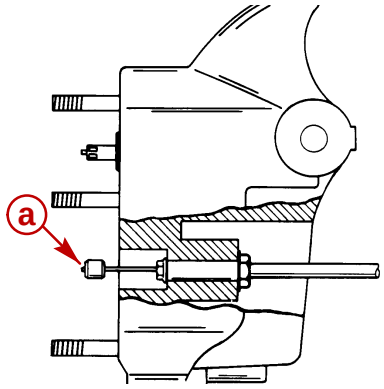
3. **Models with earlier style shift cable -** (identified by small nut which will not pass over cable anchor - core wire must be pulled from shift cable to remove cable assembly from bell housing).
   a. Remove threaded tube.



a - Jam Nut - Loosen
b - Threaded Tube - Turn Out

Index

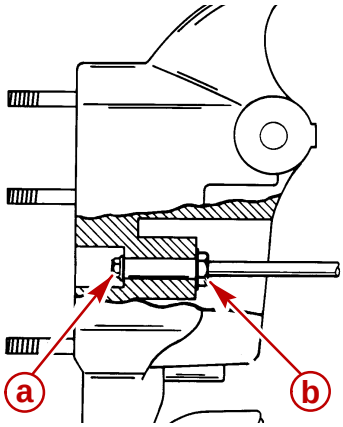
b. Remove inner core wire.



50327

a - Core Wire - Pull Out

c. Remove shift cable retaining nut. Hold inside nut with wrench.

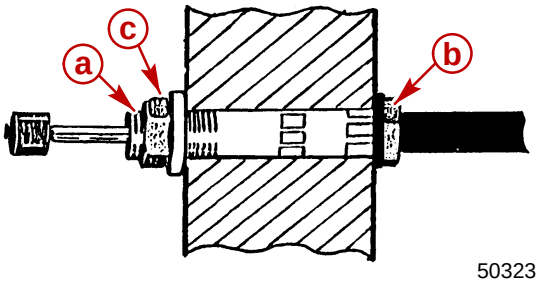


22121

a - Shift Cable Retaining Nut
b - Inside Nut

4. **Models with later style shift cable -** identified by larger nut which fits over core wire anchor; it is unnecessary to remove core wire to remove shift cable assembly.

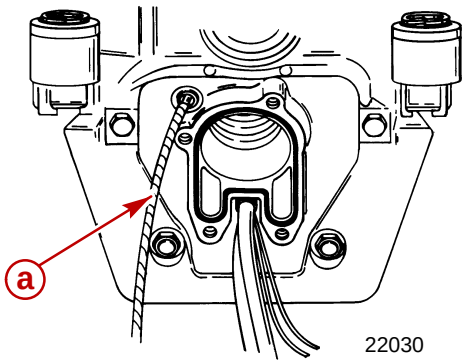
a. Remove shift cable retaining nut and washer. Hold inside nut with wrench.



50323

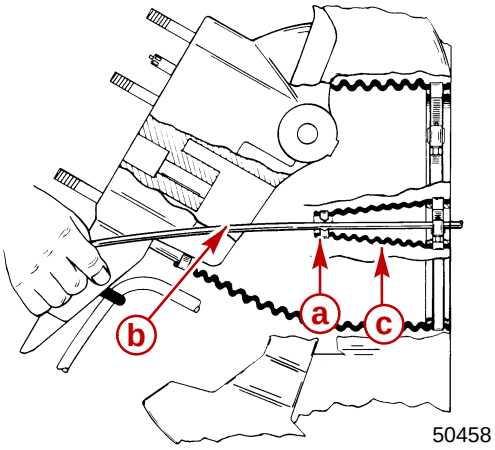
a - Shift Cable Retaining Nut
b - Inside Nut
c - Washer

5. Remove shift cable wrapping.



a - Shift Cable Wrapping

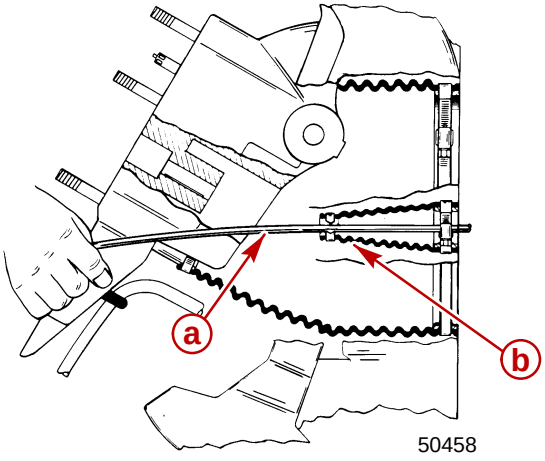
6. Loosen shift cable bellows crimp clamp.
7. Pull shift cable through shift cable bellows.



a - Crimp Clamp
b - Shift Cable
c - Shift Cable Bellows

Shift Cable Installation

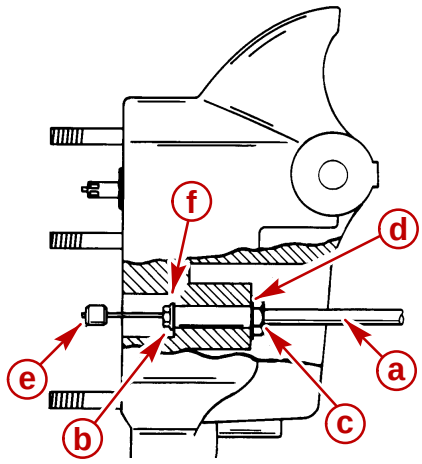
1. Insert shift cable end into and through shift cable bellows.



a - Shift Cable End
b - Shift Cable Bellows

Index

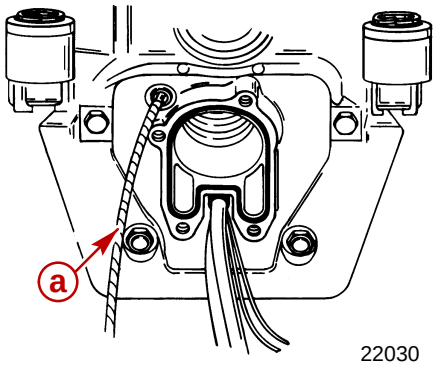
2. Apply Perfect Seal to shift cable retaining nut threads. Secure shift cable to bell housing. Hold inner nut with wrench and torque outer retaining nut to 65 lb. in. (7 N·m).



50327

a - Shift Cable
b - Outer Retaining Nut
c - Inner Nut
d - Seal Washer (Hidden by Nut)
e - Core Wire is in Later Model Cable, only (at this step of reinstallation)
f - Later Style Cable - Washer

3. Install shift cable wrapping.



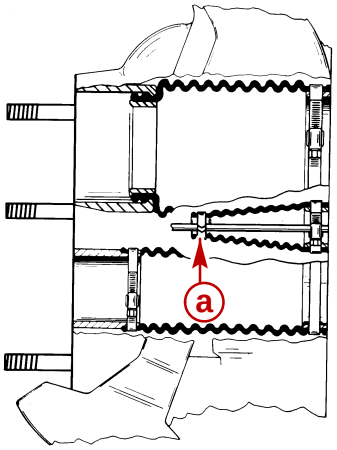
22030

a - Shift Cable Wrapping

⚠ CAUTION

Check that bellows end is not flattened out when crimping in the followlng step. Water leakage may result if clamp is not installed properly.

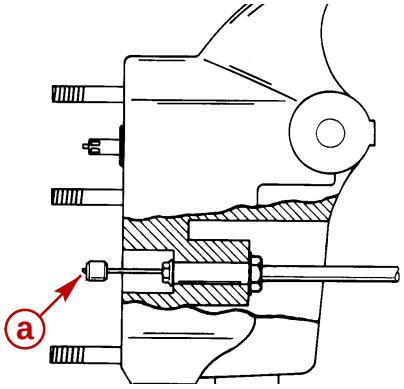
4. Install and compress shift cable bellows crimp clamp, maintaining a 1/2 in. diameter **round** O.D. Be sure that clamp is crimped evenly so that a good seal is maintained between bellows and shift cable. (Do not allow bellows to flatten.)



22117

a - Crimp Clamp

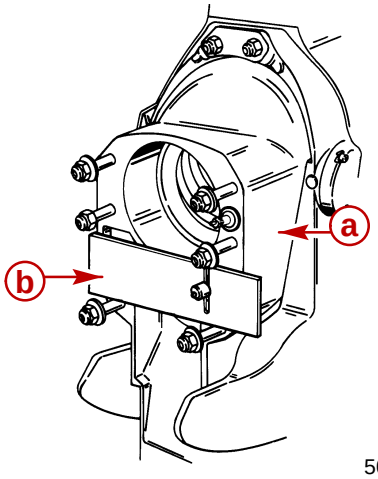
5. **Models with earlier shift cable -** install inner core wire.



50327

a - Inner Core Wire

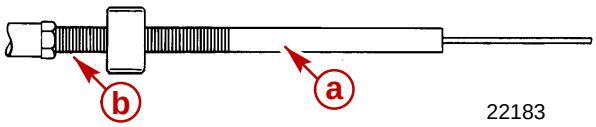
6. Install core wire locating tool (P/N 91-17263) on face of bell housing.



50327

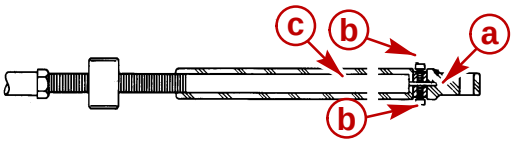
a - Bell Housing
b - Core Wire Locating Tool (P/N 91-17262A1)

7. Install threaded tube until it bottoms. Tighten finger tight. Tighten jam nut securely.



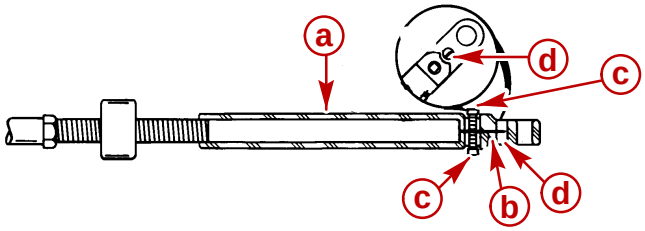
a - Threaded Tube
b - Jam Nut

8. **Earlier shift cables with support tubes -** discard support tube; do not reinstall.
9. Install cable end guide over core wire, and insert core wire through cable anchor. Tighten anchor screws evenly and torque to 20 lb. in. (2.3 N·m).



Earlier Models

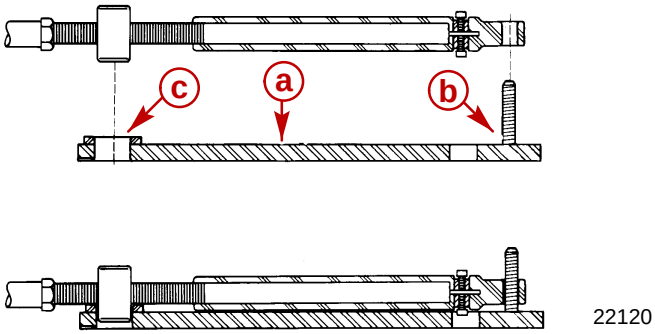
a - Core Wire
b - Anchor Screws
c - Cable End Guide



Later Models

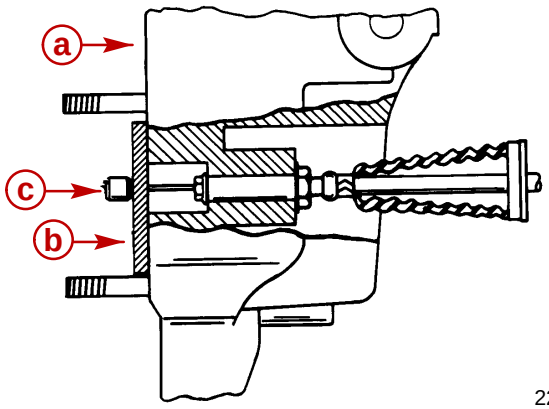
a - Cable End Guide
b - Core Wire
c - Anchor Screws
d - Sight Port - bottom-out core wire (present on all later style and some earlier style cables)

10. Place shift cable anchor adjustment tool (P/N 91-17262) on end of shift cable as shown.



a - Shift Cable Anchor Adjustment Tool (91-17262A1)
b - Stud - Placed through Hole in End Guide
c - Hole - Barrel Placed Here

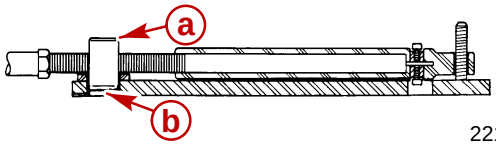
11. Ensure that bell housing end of core wire is positioned tight against core wire locating tool.



22121

a - Bell Housing
b - Core Wire Locating Tool
c - Core Wire

12. Adjust cable barrel to align with hole in tool. Remove tools and install cable on shift plate assembly, being careful not to lose adjustment.



22120

a - Barrel
b - Hole in Tool

Replacing Earlier Model Shift Cables with Later Model Shift Cables

To install the later model shift cable on all Brave transom assemblies with serial number OD542204 and lower you must enlarge the bell housing shift cable retainer hole from 3/8 in. (9.525mm) to 7/16 in. (11.113 mm). Use the Bravo Shift Cable Replacement Kit (815471A3).

All Bravo Transom Assemblies, serial number OD542205 and above, already have the latest style shift cable.

1. Remove the sterndrive unit. Refer to section 2A.
2. Compare the shift cable that was removed from the unit with the replacement shift cable.
   a. If diameter “a” is equal on both the removed cable and the replacement cable, then both cables are the later model. Install the replacement cable as outlined on page 4A-22 (Shift Cable Installation).

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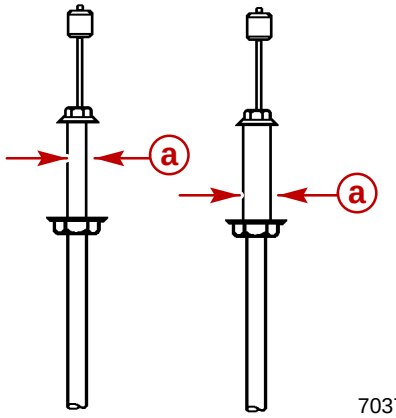
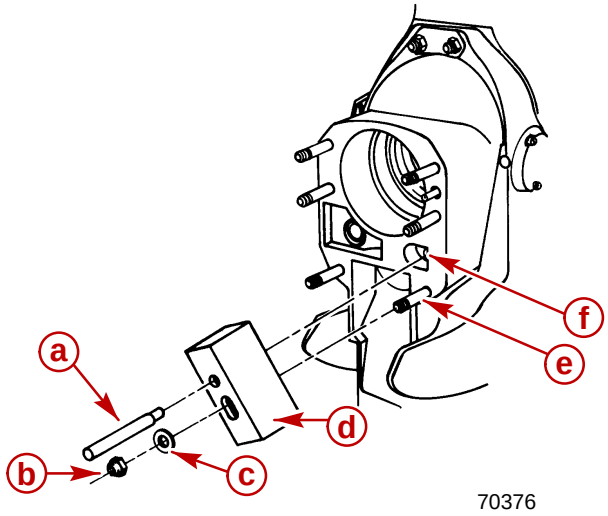
b. If diameter “a” is larger on the replacement shift cable than on the removed shift cable, proceed with the following instructions.



a - Cable Diameter

3. Slide the slotted hole of the drill bushing tool over the lowest stud closest to the bell housing shift cable bore.
4. Install the alignment rod through the round 7/16 in. hole of the bushing tool and into the bell housing shift cable bore. Make sure that it is seated fully into the bore.
5. Clamp the drill bushing tool into place using one of the nuts and washers that hold the sterndrive unit to the bell housing.

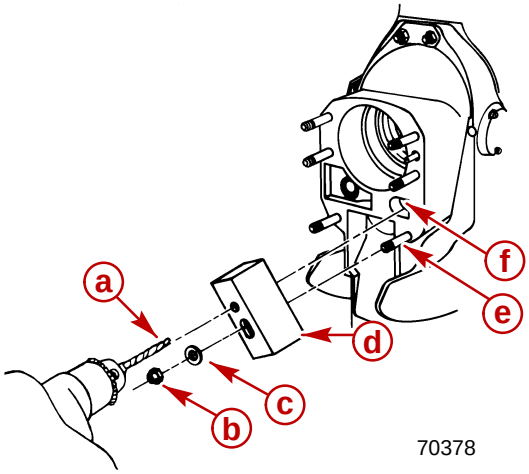


a - Alignment Rod
b - Nut
c - Washer
d - Drill Bushing Tool
e - Bell Housing Stud
f - Bell Housing Shift Cable Bore

⚠ CAUTION

Using the wrong drill may create a rough surface in the shift cable bore, allowing water leakage that could cause premature shift component failure. Use a sharp, straight drill with a 118° point and without nicks.

6. Drill through the 7/16 in. hole in the drill bushing tool and through the bell housing shift cable bore. Use the 7/16 in. drill provided in Service Tool Kit 91-818836A-1.



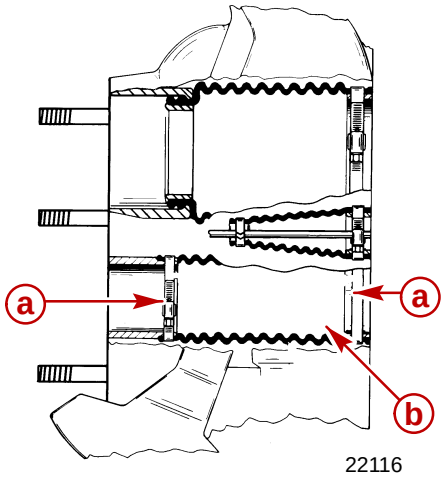
a - Drill
b - Nut
c - Washer
d - Drill Bushing Tool
e - Bell Housing Stud
f - Bell Housing Shift Cable Bore

7. Remove the drill bushing tool and clean the debris out of the bell housing. Grease the newly drilled hole with 2-4-C Marine Lubricant with Teflon.
8. Install the new shift cable per the instructions on page 4A-22.

Exhaust Bellows (If Equipped)

Removal

1. Remove sterndrive unit. Refer to Section 2A.
2. Loosen clamps and remove bellows.



a - Clamps
b - Bellows

Index

Cleaning and Inspection

1. Inspect exhaust bellows for internal charring, cracks, cuts or hardening.
2. Clean old adhesive from bellows mounting flange on gimbal housing and on bell housing with lacquer thinner.
3. Clean old adhesive from mounting surface of exhaust bellows if using old bellows.
4. Roughen exhaust bellows mating surfaces with sandpaper and wipe clean with lacquer thinner.

Installation

⚠ WARNING

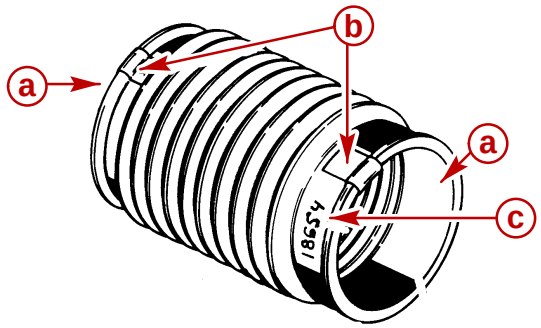
Be sure to follow label directions when using bellows adhesive.

1. Apply bellows adhesive to mounting surfaces on inside of bellows. Allow adhesive to dry until no longer tacky, (approximately 10 min.).

⚠ CAUTION

Bellows clamps may corrode if grounding clips are not installed.

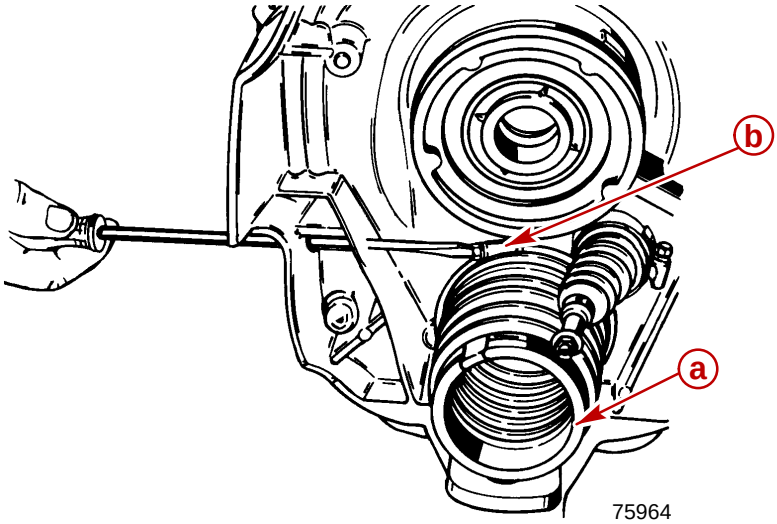
2. Position grounding clips on bellows.



22079

a - Apply Bellows Adhesive
b - Grounding Clips
c - Part Number - all replacement bellows should be P/N 18654. Do not use earlier model bellows.

3. Install exhaust bellows on gimbal housing. Torque to 35 lb. in. (4 N·m).

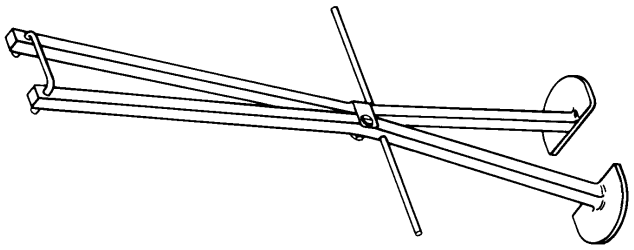


75964

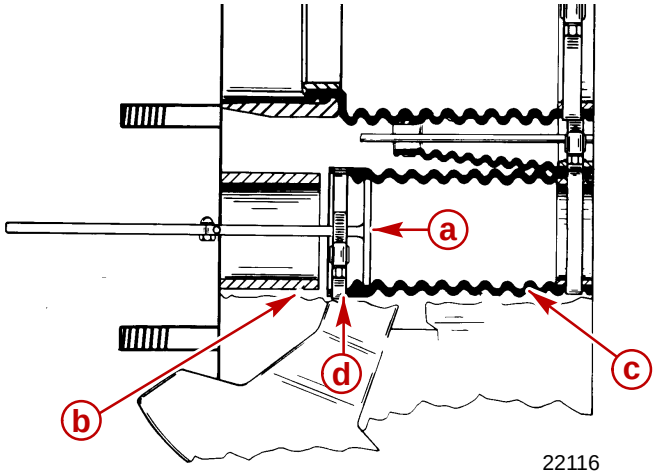
a - Exhaust Bellows
b - Hose Clamp

Index

4. Install exhaust bellows on bell housing as follows:
   a. Place hose clamp over bellows end.
   b. Place expander tool (91-45497A1) into first bellows convolution.


22161

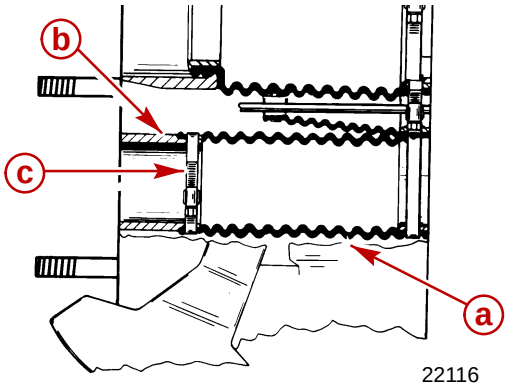
   c. Pull tool until tool touches the flange on bell housing (hose starts to slip onto flange); then release tool.



22116

a - Expander Tool (91-45497A1)
b - Bell Housing Flange
c - Exhaust Bellows
d - Hose Clamp

   d. Reposition tool into the third bellows convolution.
   e. Pull bellows onto bell housing flange.
   f. Torque hose clamp to 35 lb. in. (4 N·m).



22116

a - Exhaust Bellows
b - Bell Housing Flange
c - Hose Clamp

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Exhaust Tube (If Equipped)

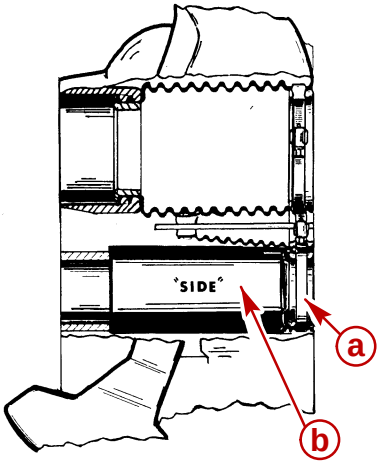
Removal

NOTE: *It is not necessary to remove drive unit when replacing exhaust tube.*

⚠ CAUTION

Support aft end of drive unit as an added safety measure when working between bell housing and gimbal housing.

1. Raise drive unit to the full “Up” position.
2. Loosen clamp and remove exhaust tube.



22184

a - Clamp
b - Exhaust Tube

Cleaning and Inspection

1. Inspect exhaust tube for charring, cracks, cuts and hardening.
2. Roughen exhaust tube mating surfaces with sandpaper and wipe clean with lacquer thinner.

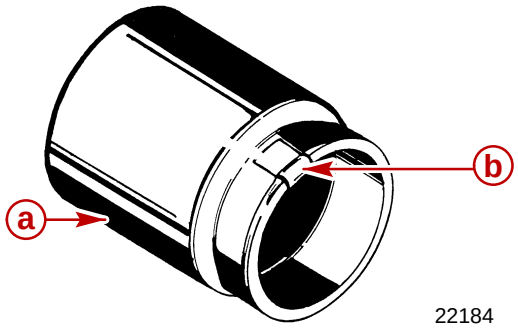
Installation

NOTE: *Bellows adhesive is not used when installing an exhaust tube.*

⚠ CAUTION

Exhaust tube clamp may corrode if grounding clip is not installed.

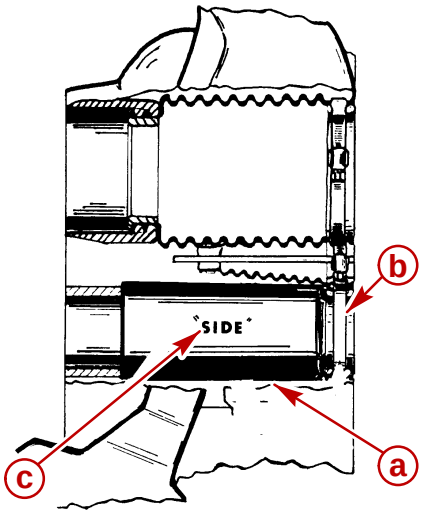
1. Position grounding clip on exhaust tube as shown.



22184

a - Exhaust Tube
b - Grounding Clip

2. Install exhaust tube on gimbal housing as follows:
   a. Position tube so that “SIDE” markings on tube are facing toward the right and left sides.
   b. Position clamp so that screw will align with screwdriver access hole in port (left) side of gimbal housing.
   c. Tighten clamp. Torque to 35 lb. in. (4 N·m).



22184

a - Exhaust Tube
b - Clamp
c - “Side” Marking

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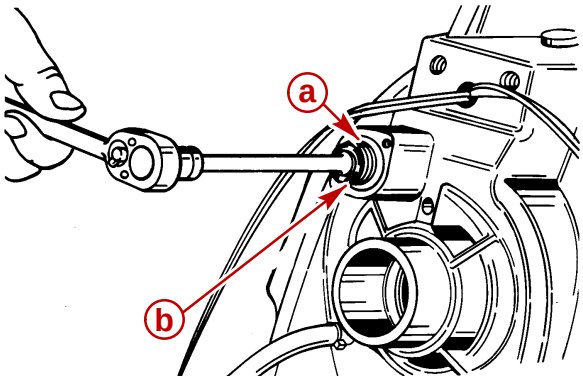
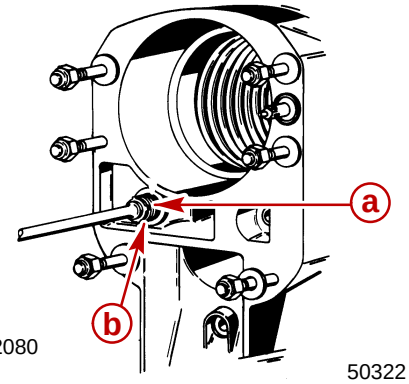
Water Hose and Water Fitting

Removal

1. Remove tapered inserts.



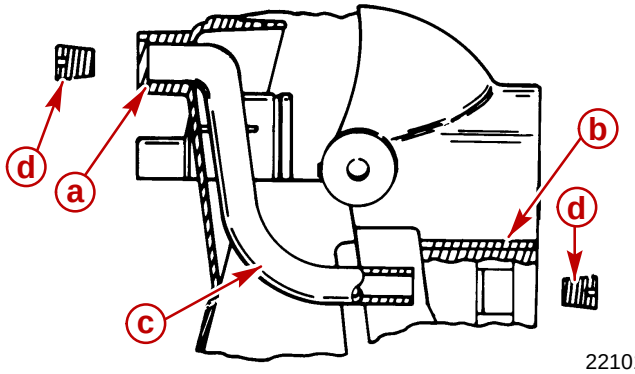
22080



50322

a - Tapered Inserts
b - Tapered Insert Tool (91-43579)

2. Remove water hose.



22101

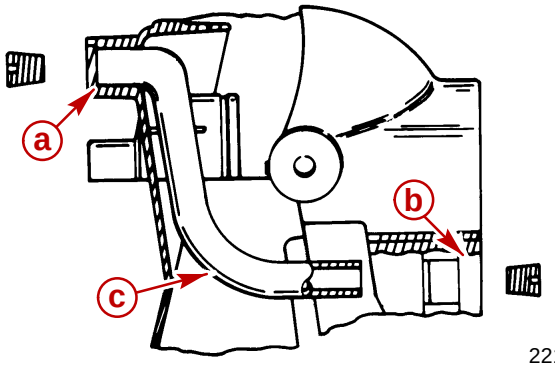
a - Gimbal Housing
b - Bell Housing
c - Water Hose
d - Tapered Inserts

Installation

⚠ CAUTION

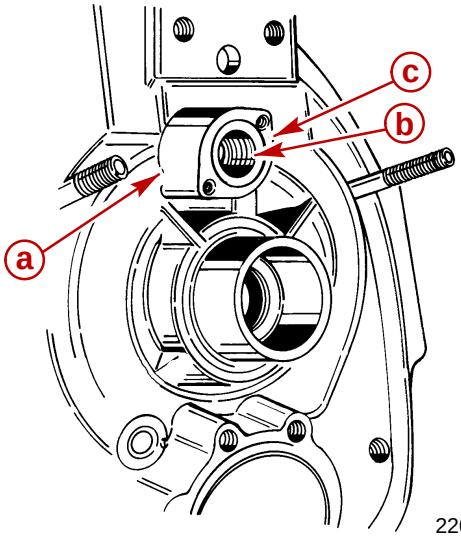
The water hose, in the following step is a preformed hose, and must be installed with the short end of the molded hose going into the gimbal housing, and must be held in place while installing the tapered inserts. Failure to hold hose in place can result in the hose turning and kinking, which could restrict water flow, and/or crack and leak or suck in air, creating an overheat condition.

1. Position water hose as follows:
   a. Gimbal Housing - Hose edge must be flush with mounting surface.
   b. Bell Housing - Hose edge should protrude approximately 1/8 in. from edge of hole.



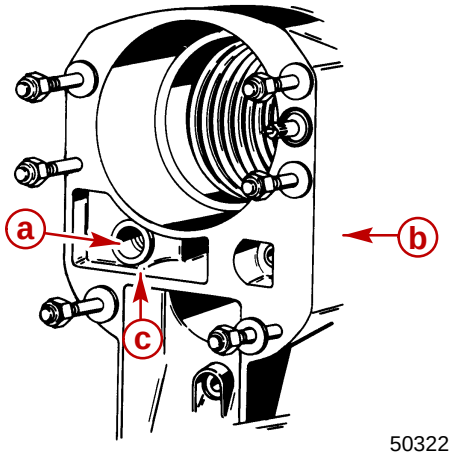
22101

a - Gimbal Housing
b - Bell Housing
c - Water Hose



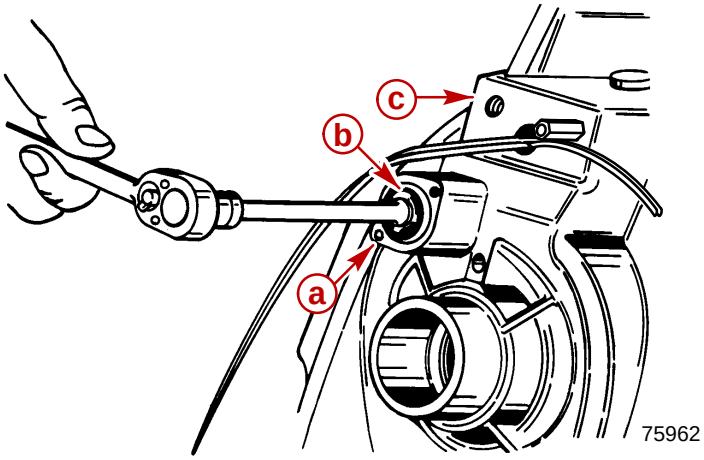
22080

a - Gimbal Housing
b - Water Hose
c - Mounting Surface

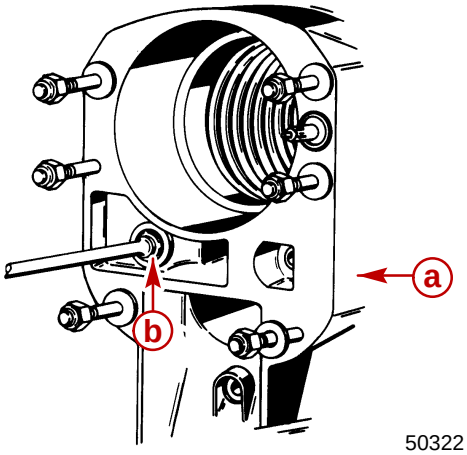


a - Bell Housing
b - Water Hose
c - Hole

2. Apply a small amount of 2-4-C Marine Lubricant with Teflon to threads and install tapered inserts with tapered insert tool (91-43579).



a - Tapered Insert
b - Tapered Insert Tool (91-43579)
c - Gimbal Housing



a - Bell Housing
b - Tapered Insert Tool

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TRANSOM ASSEMBLY

Section 4B - Service Procedures Requiring Major Disassembly

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4 B

Bravo Transom Assembly Specifications

Torque Specifications

DESCRIPTION	TORQUE		
	lb. in.	lb. ft.	N·m
Shift Cable Core Wire Anchor Screws	20		2.3
Bellows Hose Clamps	35		4
Hinge Pins		150	203
Through Bolt Locknut		25	34
Pivot Bolt		23	30
U-Bolt Nuts		50-55	67-74
Bellows Clamps		35	47
Sterndrive Attaching Nut		23	30
90° Hose-Barb Compression Fitting	80		9
90° Fitting Nut		12	16

Lubricants/Sealers/Adhesives

DESCRIPTION	PART NUMBER
3M Brand Adhesive	92-86166-1
Liquid Neoprene	92-25711-2
Resiweld Sealer	92-65150-1
Loctite 27131	92-809820
Quicksilver 2-4-C Marine Lubricant with Teflon	92-825407A12

Special Tools

DESCRIPTION	PART NUMBER
Bearing Removal and Installation Tool	91-31229A7
Bellows Expander Tool	91-45497A1
Slide Hammer Puller	91-34569A1
Tapered Insert Tool	91-43579
Core Wire Locating	91-17263
Shift Cable Anchor Adjustment Tool	91-17262
Sleeve Removal Tool (U-joint Bellows)	91-818169
Sleeve Installation Tool (U-joint Bellows)	91-818162
Hinge Pin Puller (High Performance Transom Assembly)	91-63616

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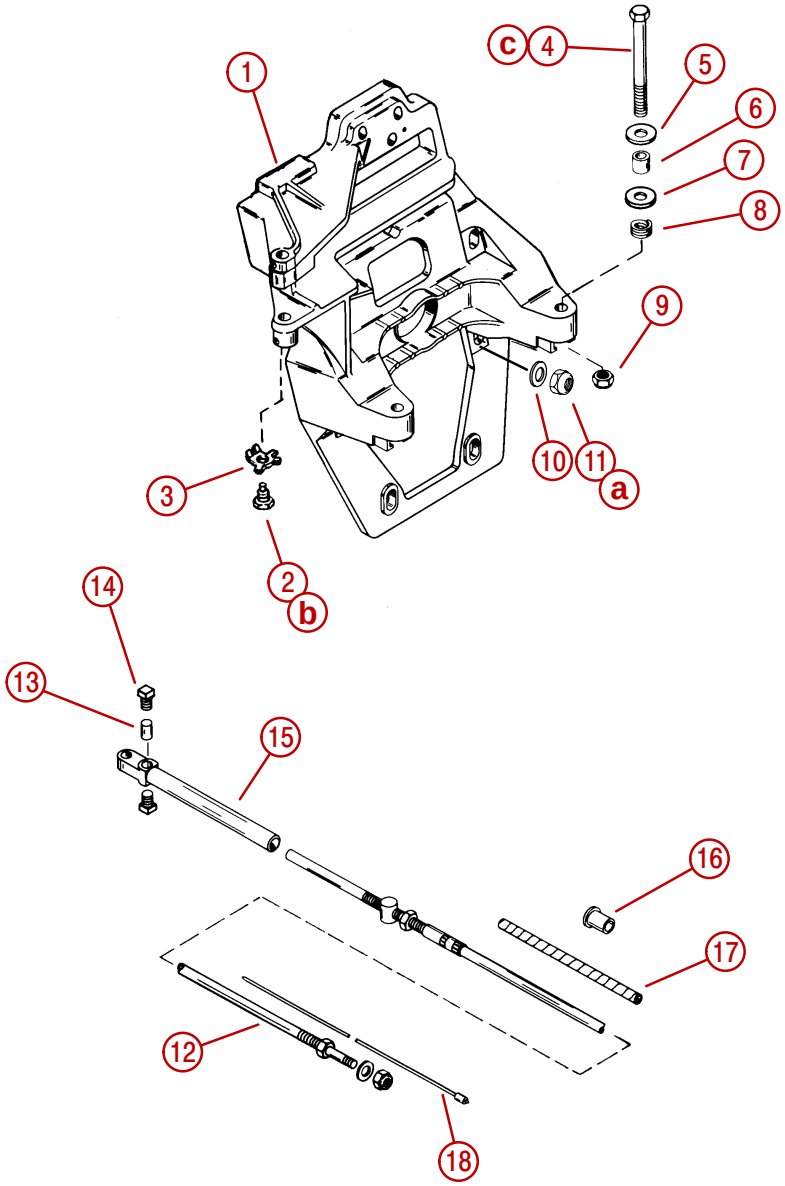
Bravo Transom Assembly Exploded Views

Inner Transom Plate Components



74850

1 - Transom Plate Assembly
2 - Pivot Bolts
3 - Tab Washers
4 - Screw Engine Mounting
5 - Washer
6 - Spacer
7 - Washer - Fiber
8 - Lockwasher - Double Wound
9 - Locknut
10- Washer
11- Locknut
12- Shift Cable Casing
13- Core Wire Anchor
14- Anchor Screws (2)
15- End Guide
16- Pilot Bushing - Gimbal Housing
17- Core Wire

Torque Specifications

(a) 25 lb. ft. (34 N·m)
(b) 23 lb. ft. (30 N·m)
(c) 37 lb. ft. (50 N·m)

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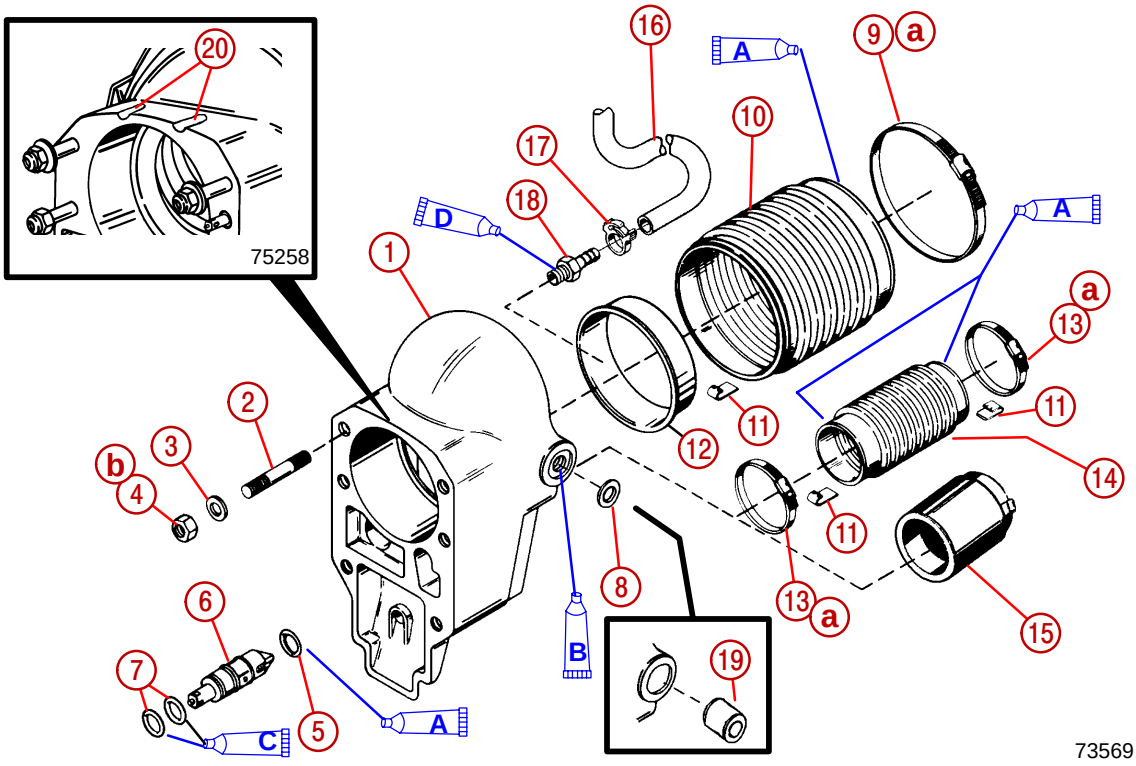
Bell Housing Components



1 - Bell Housing	12- Sleeve
2 - Stud	13- Bellows Clamp
3 - Washer	14- Exhaust Bellows
4 - Locknut	15- Exhaust Tube (Some Models)
5 - O-ring	16- Speedometer Hose
6 - Gear Lube Valve	17- Hose Clamp
7 - O-rings	18- Bayonet Fitting
8 - Hinge Pin Washer	19- Bushing (High Performance Transom)
9 - Bellows Clamp	20- Indentations in Later Style Bell Housing (Must Be Used With Trim-In Limit Pins)
10- U-Joint Bellows	
11- Grounding Clip	

Lubricants/Sealers/Adhesives

A - 3M Brand Adhesive 92-86166-1

B - Loctite 27131 92-809820

C - Quicksilver High Performance Gear Lube 92-816026A4

D - Quicksilver Perfect Seal 92-34227-1

Torque Specifications

(a) Tighten Securely -Approximately 35 lb. in. (4 N·m)

(b) 50 lb. ft. (68 N·m)

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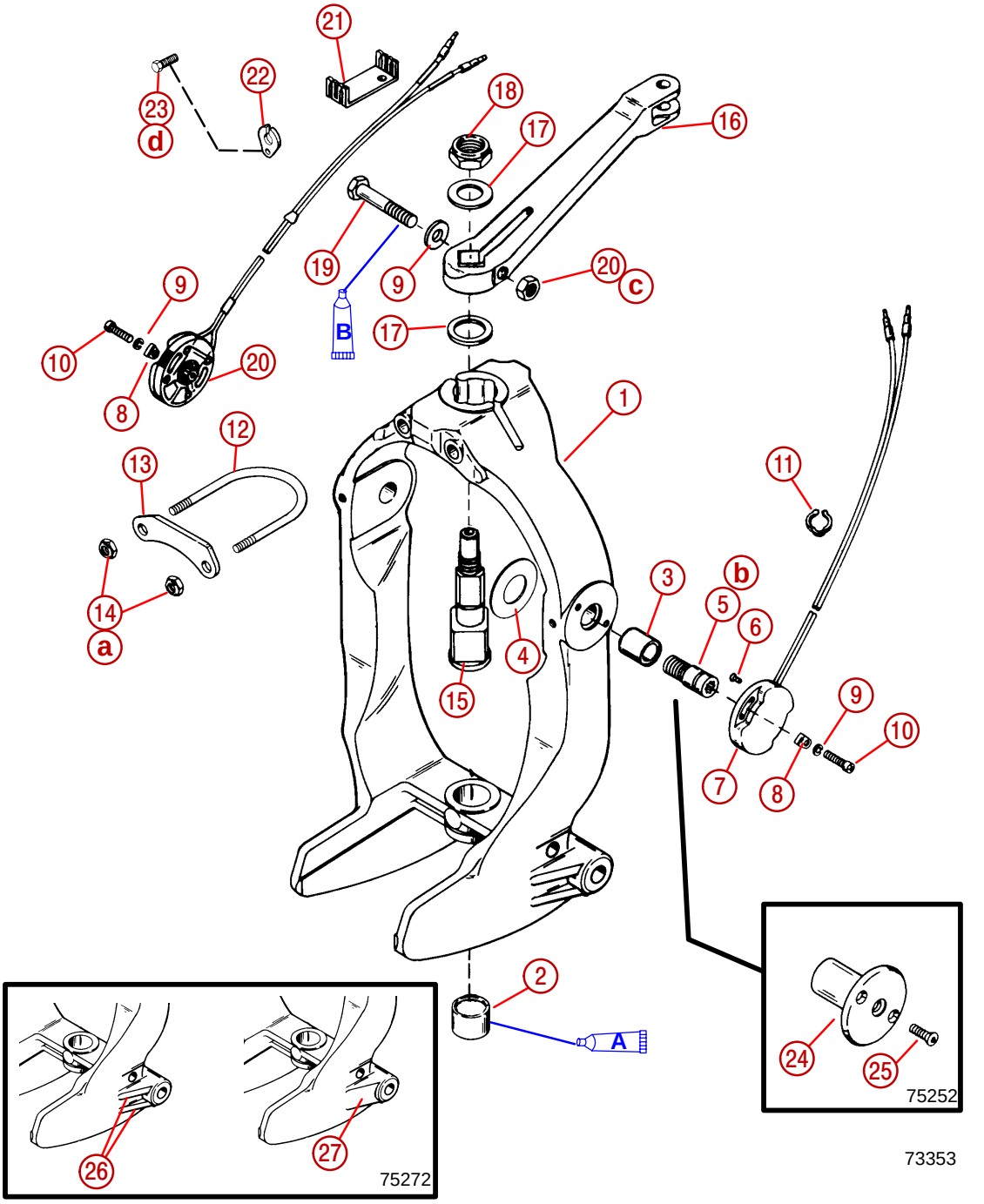
Gimbal Ring Components



1 - Gimbal Ring	15- Swivel Shaft
2 - Bushing	16- Steering Lever
3 - Bushing	17- Washer (Smaller I.D.)
4 - Washer	18- Washer (Larger I.D.)
5 - Hinge Pin	19- Clamp Screw
6 - Screw	20- Nut
7 - Trim Position Sender	21- Wire Retainer
8 - Clip	22- Trim Wire Clamp
9 - Washer	23- Screw
10- Screw	24- Hinge Pin (High Performance Transom Only)
11- Clip	25- Screws (High Performance Transom Only)
12- U-Bolt	26- Standard Gimbal Ring Identification. (Two Ribs)
13- Plate	27- Magnum and High Performance Gimbal Ring Identification. (Filled Area)
14- Locknuts	

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Lubricants/Sealers/Adhesives

- Resiweld Sealer 92-65150-1

- Quicksilver 2-4-C Marine Lubricant with Teflon 92-825407A12

Torque Specifications

(a) 50-55 lb. ft. (67-74 N·m)

(b) 150 lb. ft. (203 N·m)

(c) 45-55 lb. ft. (61-74 N·m)

(d) 90-100 lb. in. (10-11 N·m)

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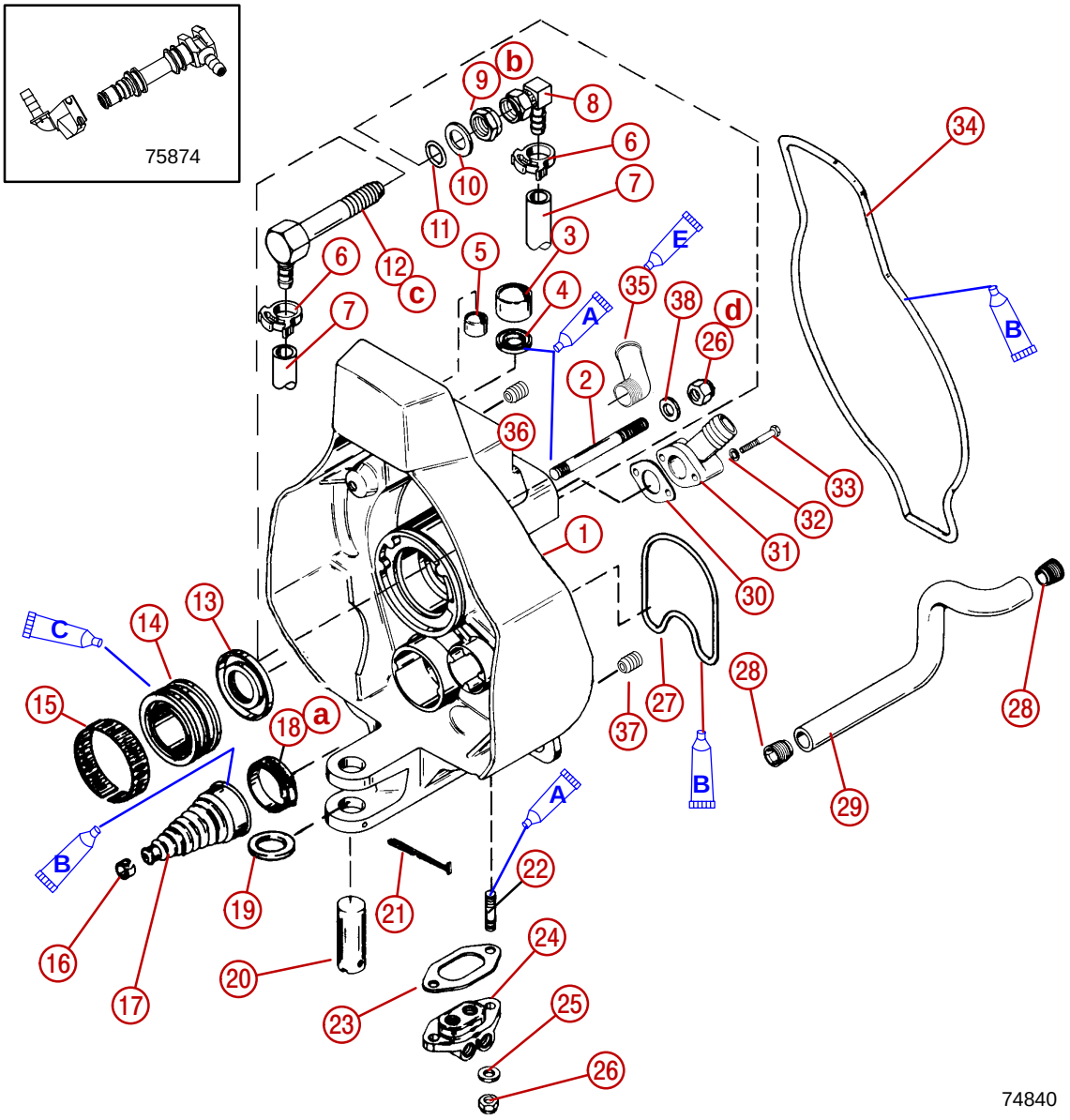
Gimbal Housing Components



1 - Gimbal Housing	21- Cotter Pin
2 - Stud	22- Stud
3 - Lower Bushing	23- Gasket
4 - Seal	24- Hydraulic Manifold
5 - Upper Bushing	25- Lockwasher
6 - Clamp	26- Locknut
7 - Gear Lube Hose	27- Exhaust Passage O-ring
8 - Swivel Fitting	28- Water Hose Insert
9 - Locknut	29- Water Hose
10- Washer	30- Water Fitting Gasket
11- O-ring	31- Water Fitting
12- Gear Lube Fitting	32- Lockwasher
13- Seal	33- Screw
14- Gimbal Bearing	34- Gimbal Housing Seal
15- Tolerance Ring	35- Water Bypass Fitting (Some Diesel Models)
16- Crimp Clamp	36- Pipe Plug (or Speedometer Fitting - Later Style)
17- Shift Cable Bellows	37- Pipe Plug (or Speedometer Fitting - Earlier Style)
18- Bellows Clamp	38- Washer
19- Washer	
20- Lower Swivel Pin	

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Lubricants, Sealers, and Adhesives

- Loctite 27131 92-809820

- 3M Brand Adhesive 92-86166-1

- Quicksilver U-Joint and Gimbal Bearing Grease 92-828052A2

- Super Glue . . . . . Obtain Locally

- Perfect Seal 92-34227-1

Torque Specifications

(a) Tighten Securely - Approximately 35 lb. in. (4 N·m)

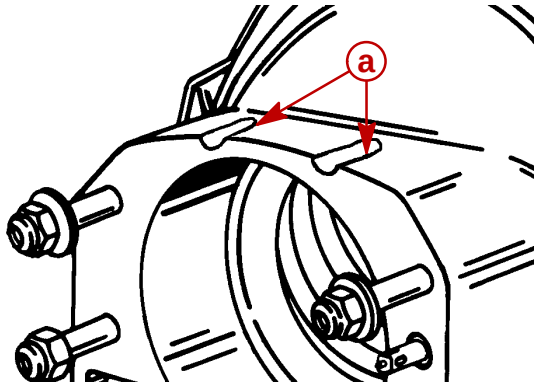
(b) 12 lb. ft. (16 N·m)

(c) 80 lb. in. (9 N·m)

(d) 25 lb. ft. (34 N·m)

Bell Housing Removal

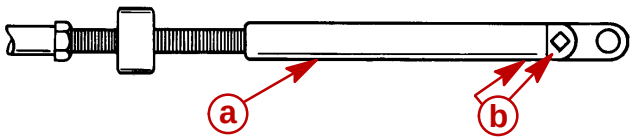
NOTE: *If drive shaft housing is equipped with Trim-In Limit Pins, the bell housing shown in the following illustration must be used. There are two indentations in the top aft edge of the bell housing. These indentations help prevent scratching of the top side of the bell housing by the gimbal ring U-bolt, when the trim-in limit pin is positioned in the aft position (Refer to Sec. 5B for Trim-In Limit Pin Information.)*



75258

a - Indentations

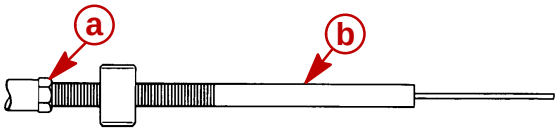
1. Remove sterndrive unit (refer to Section 2A).
2. Remove shift cable from bell housing.
   a. Disconnect shift cable end guide from shift bracket and remove end guide.



22183

a - End Guide
b - Anchor Screws - Loosen

3. **Models with earlier style shift cable -** (identified by small nut which will not pass over cable anchor - core wire must be pulled from shift cable to remove cable assembly from bell housing).
   a. Remove threaded tube.



22183

a - Jam Nut - Loosen
b - Threaded Tube - Turn Out

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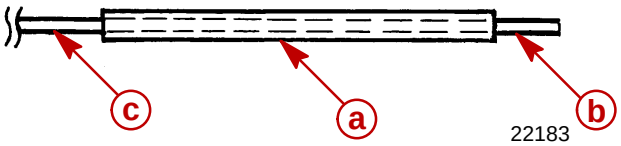
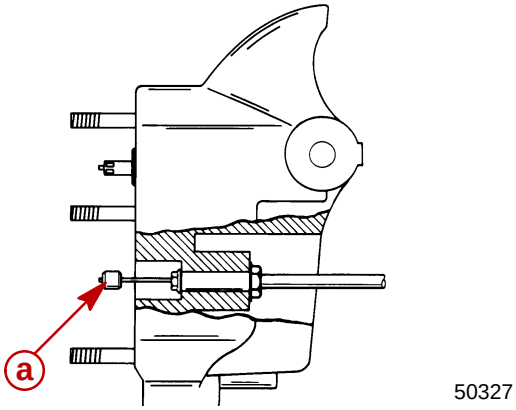
b. Remove support tube from core wire. Do not cut core wire, unless absolutely necessary.



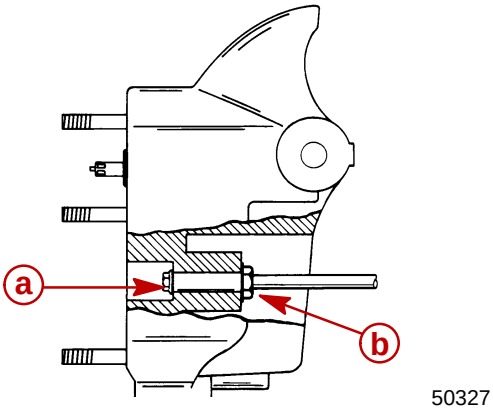
a - Support Tube - Remove Crimp - Remove - Discard (not needed)
b - Core Wire
c - Cut Here, If Absolutely Necessary

c. Remove inner core wire.



a - Core Wire - Pull Out

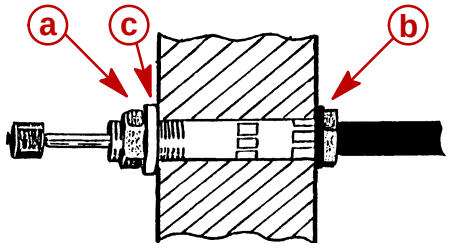
d. Remove shift cable retaining nut. Hold inside nut with wrench.



a - Shift Cable Retaining Nut
b - Inside Nut

4. **Models with later style shift cable** - identified by larger nut which fits over core wire anchor; it is unnecessary to remove core wire to remove shift cable assembly.

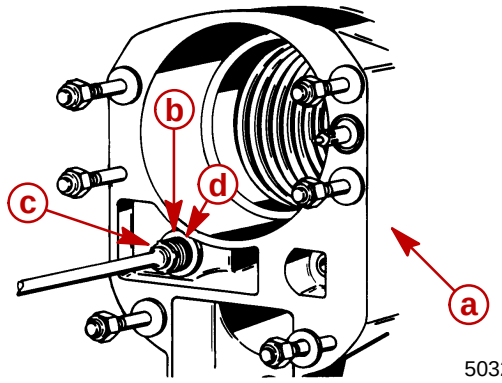
Remove shift cable retaining nut and washer. Hold inside nut with wrench.



50323

a - Larger Shift Cable Retaining Nut
b - Inside Nut
c - Washer

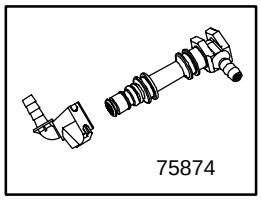
4. Remove water hose insert from I.D. of water hose and remove water hose from bell housing.



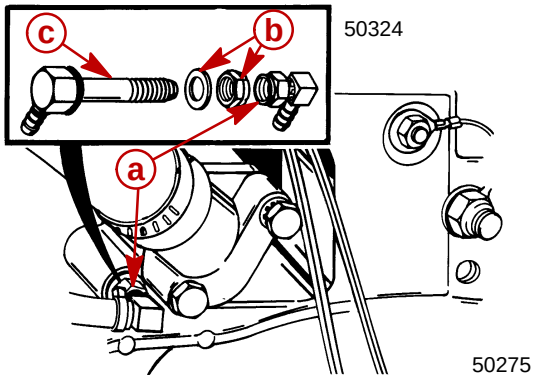
50322

a - Bell Housing
b - Tapered Insert - Turn Counterclockwise
c - Tapered Insert Tool (91-43579)
d - Water Hose

5. **Models with Gear Lube Monitor** - remove Gear Lube Monitor 90° hose barb fitting, and nut and washer from thru-bulkhead fitting, so that fitting will pull out of gimbal housing upon removal of bell housing.



75874



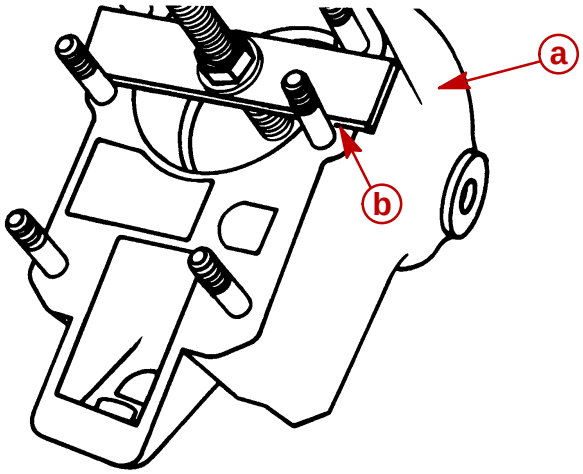
50324

50275

a - Barb Fitting
b - Nut and Washer
c - Thru-Bulkhead Fitting

Index

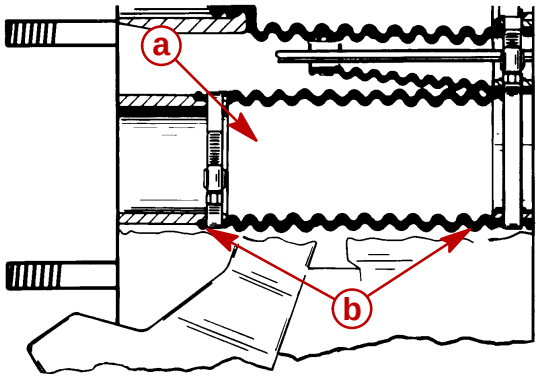
6. Spray engine cleaner around edge of bellows sleeve and remove with U-joint bellows sleeve removal tool P/N 91-818169.



71526

a - Bell Housing
b - U-Bellows Sleeve Removal Tool (91-818169)

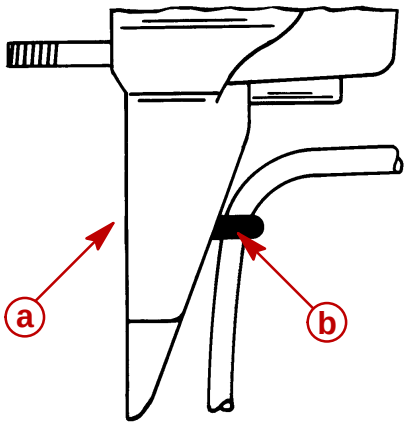
7. Remove exhaust bellows from bell housing.



22116

a - Exhaust Bellows
b - Hose Clamps - Loosen

8. Remove speedometer tubing clip from bell housing.

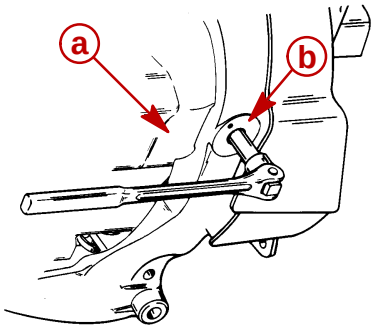


22121

a - Bell Housing
b - Speedometer Tubing Clip - Remove

Index

9. **On Standard Transom Assembly -** Remove hinge pins.

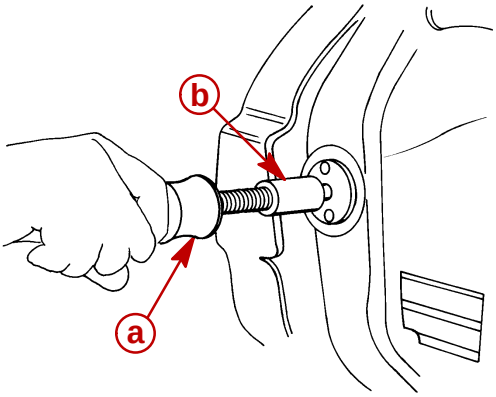


22113

a - Bell Housing
b - Hinge Pins - Remove (Port and Starboard)

10. **On High Performance Transom Assembly -** Remove hinge pins using special tool (91-63616) and slide hammer as follows:

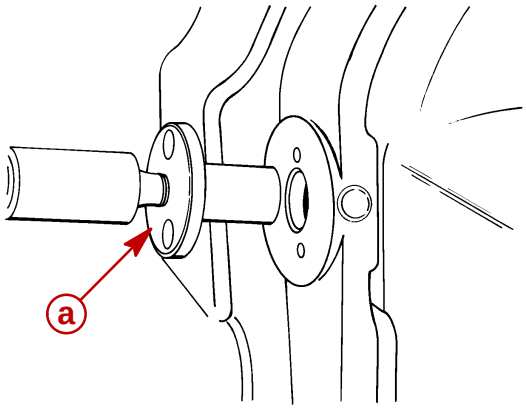
a. Thread special tool into hinge pin.



71826

a - Slide Hammer
b - Special Tool

b. Remove hinge pins.



71828

a - Hinge Pin

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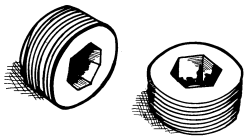
Access Plug Kit Installation

NOTE: *If steering lever cavity is not accessible, it will be necessary to drill access holes in gimbal housing. This procedure requires the following:*

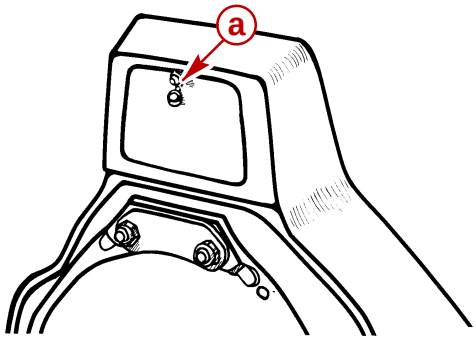
Access Plug Kit 22-88847A-1
1-1/8 in. Hole Saw (obtain locally)
1 in. NPT Pipe Tap (obtain locally)

IMPORTANT: Do not use the templates which come with access plug kit. These templates will not work on this drive unit gimbal housing.



22756

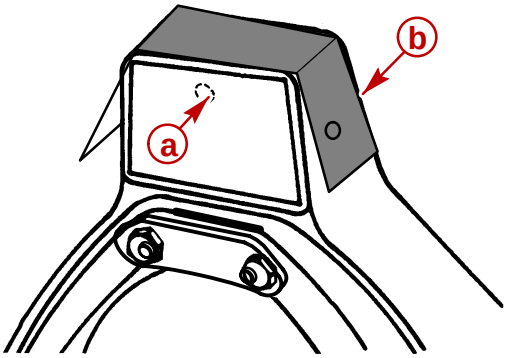
1. **Earlier Models** - lubricate upper swivel shaft with a liberal amount of 2-4-C Marine Lubricant with Teflon. This will help to prevent metal chips from getting into bearings when cutting holes, following.



75905

a - Swivel Shaft Grease Fitting (Early Models only)

2. Use template at the end of this section as a guide for the correct location for cutting and drilling access holes. Align template with dimple located beneath decal on the gimbal housing.



75914

a - Dimple (Beneath decal)
b - Template

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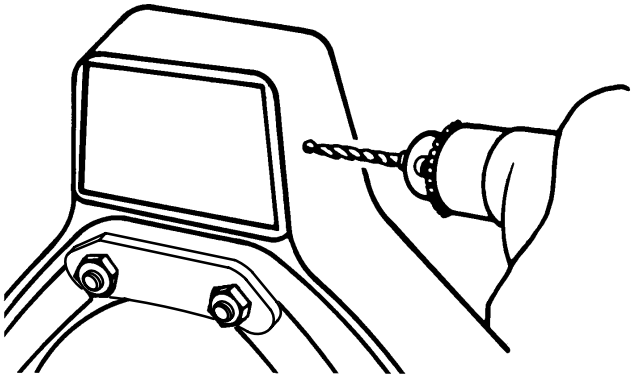
⚠ CAUTION

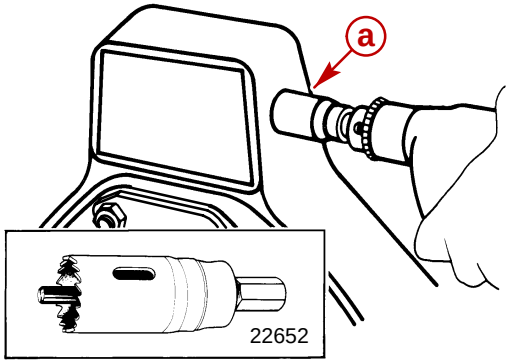
Be sure to drill and cut hole and tap threads perpendicular to gimbal housing surfaces in the following steps.

3. Drill pilot holes (port and starboard) using a drill that is the same size as the pilot rod being supplied with the hole saw (approximately 1/4 in.) (6mm).



75915

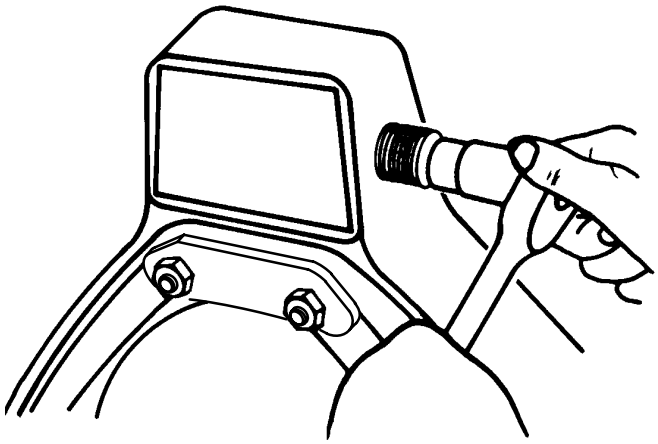
4. Cut holes in gimbal housing (port and starboard) using 1-1/8 in. hole saw and pilot rod. Remove metal chips with compressed air.

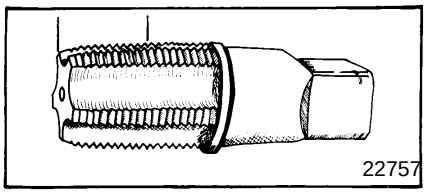


70153

a - Hole Saw

5. Mark 1 in. pipe tap with a piece of tape, 1-1/8 in. (28mm) from end of tap. Cut threads in access holes. Stop cutting when the edge of the tape reaches the gimbal housing. Coat pipe tap with grease to aid in picking up metal chips.





75904

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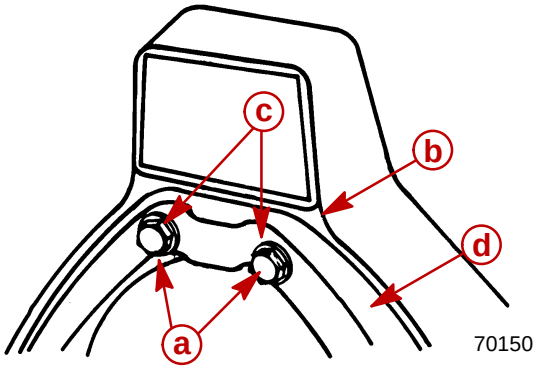
Gimbal Ring, Swivel Shaft and Steering Lever Removal

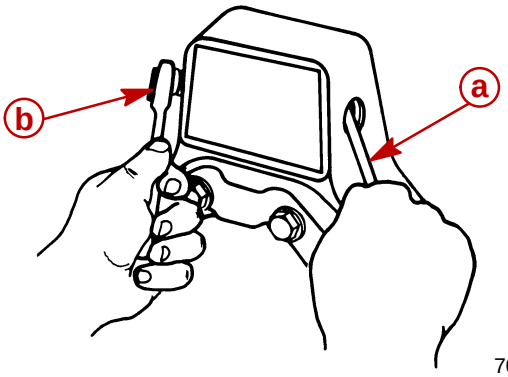
1. Loosen screws and nuts (not necessary to remove).



70150

a - Screws (2)
b - Nuts (2)
c - Washers (4)
d - Gimbal Ring

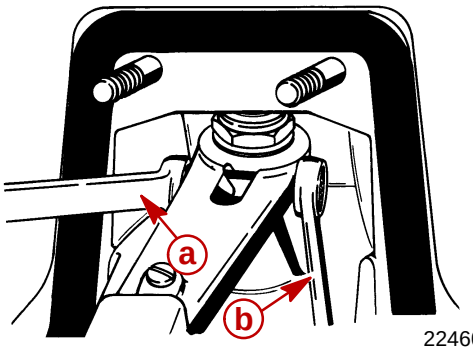
2. Loosen steering lever clamping bolt and nut.



70157

Engine and transom assembly installed.

a - Wrench
b - Socket Wrench



22460

Engine and transom assembly removed.

a - Wrench
b - Wrench

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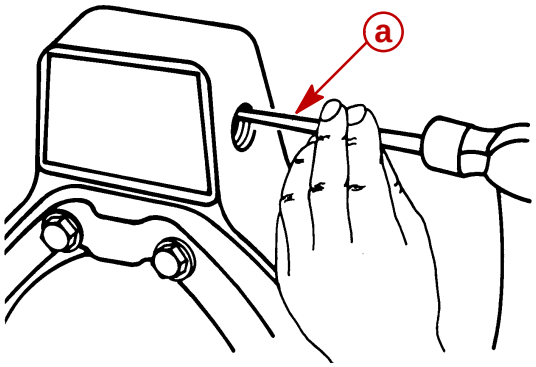
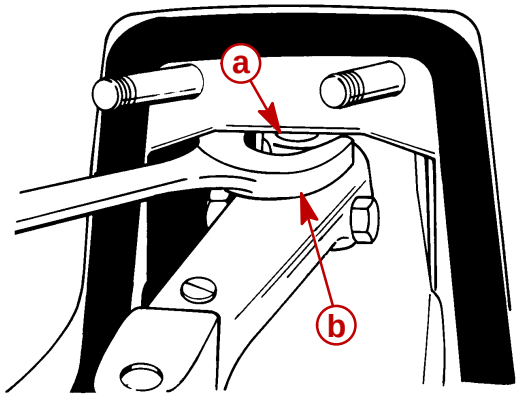
3. Remove locknut.



70156

Engine And Transom Assembly Installed

a - Pin Punch

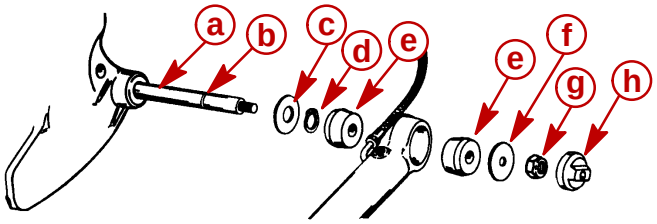


22452

Engine And Transom Assembly Removed

a - Locknut
b - 1-1/16 in. Wrench

4. Disconnect trim cylinders from gimbal ring (if not already done). Suspend cylinders to avoid damage to hoses.

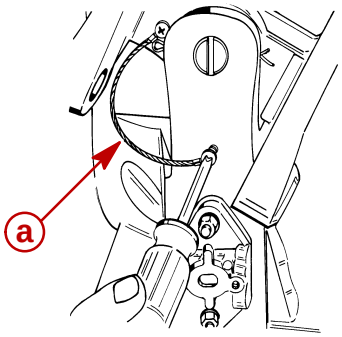


71489

a - Anchor Pin (1)
b - Slots (2)
c - Flat Washer (Large I.D.) (2)
d - Snap Rings (2)
e - Rubber Bushings (4)
f - Flat Washer (Small I.D.) (2)
g - Locknut (2)
h - Plastic Cap (2)

Index

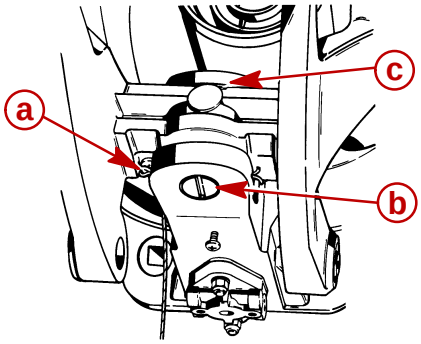
5. Disconnect continuity wire.



22261

a - Continuity Wire

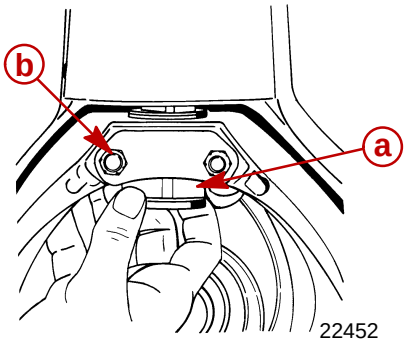
6. Remove cotter pin, lower swivel pin and washer.



22461

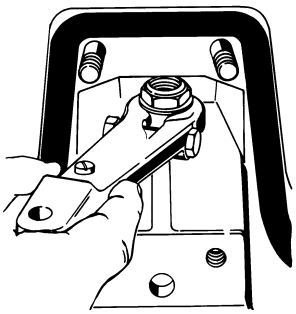
a - Cotter Pin
b - Lower Swivel Pin
c - Washer

7. Remove upper swivel shaft from gimbal ring, large I.D. washer, steering lever, small I.D. washer, and locknut.

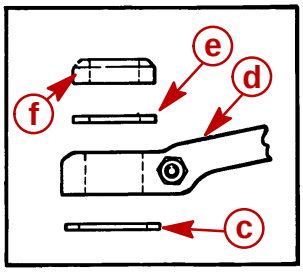


22452

a - Upper Swivel Shaft
b - Gimbal Ring



22463



22492

c - Washer
d - Steering Lever
e - Small I.D. Washer
f - Locknut

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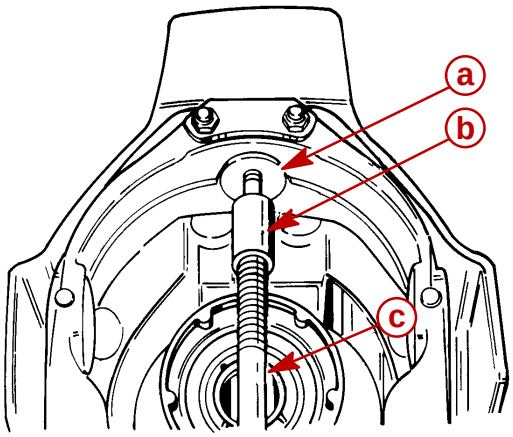
IMPORTANT: If swivel shaft is seized, remove shaft using slide hammer puller (91-34569A1) and puller head (91-63616). Bell housing and bellows must be removed.



22259

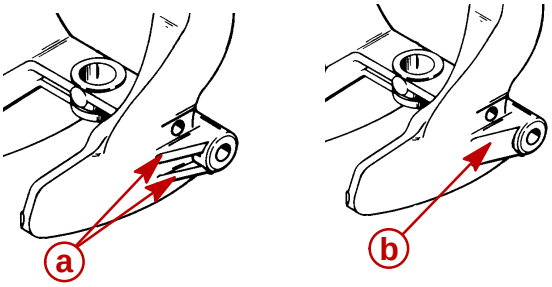
a - Swivel Shaft
b - Puller Head
c - Slide Hammer

8. Remove gimbal ring.

Gimbal Ring Servicing

GIMBAL RING IDENTIFICATION

The gimbal ring used on various model transom assemblies can be identified as shown in the following illustration:



75272

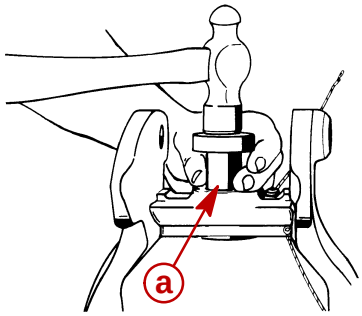
a - Standard Gimbal Ring Identification. (Two Ribs)
b - Magnum and High Performance Gimbal Ring Identification. (Filled Area)

REMOVING BUSHINGS

⚠ CAUTION

Be careful not to damage bores when removing self-lubricating bushings in the following steps.

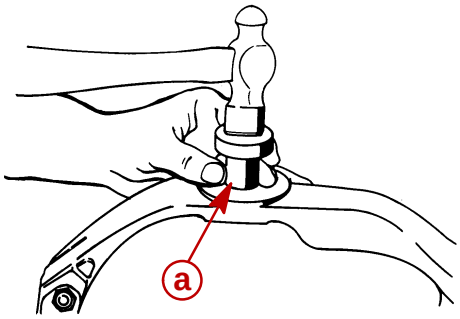
1. Tap out and remove gimbal ring lower swivel pin bushing using a suitable mandrel.



22451

a - Suitable Mandrel

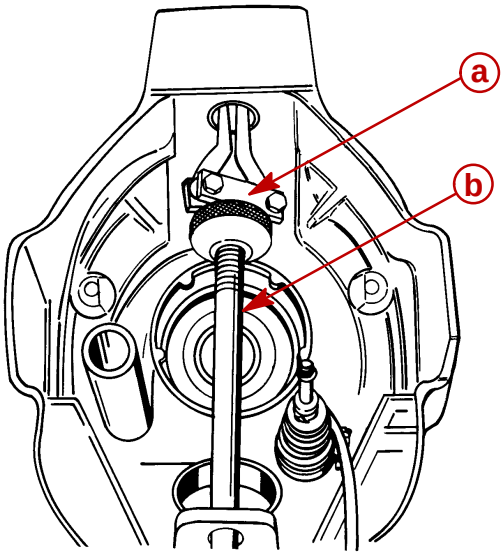
2. Remove gimbal ring hinge pin bushings (port and starboard) using a suitable mandrel.



22452

a - Suitable Mandrel - Tap Out Hinge Pin Bushings

3. Remove oil seal and large bushing from gimbal housing using a two-jaw puller and slide hammer assembly.



22452

a - Two Jaw Puller
b - Slide Hammer Assembly

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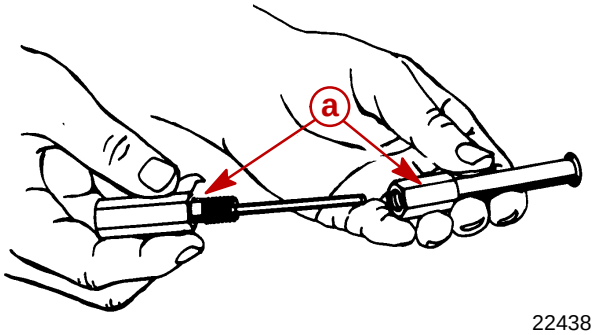
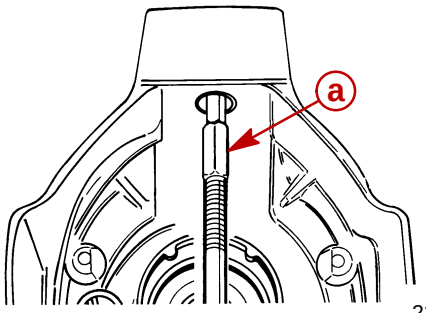
4. Remove small bushing from gimbal housing using a bushing removal tool. (Snap On Tool Company P/N CG40CB).



22438

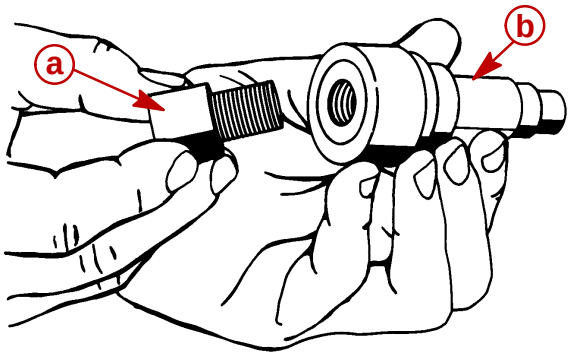


22454

a - Bushing Removal Tool (Snap On Tool Company P/N CG40CB)

INSTALL BUSHINGS

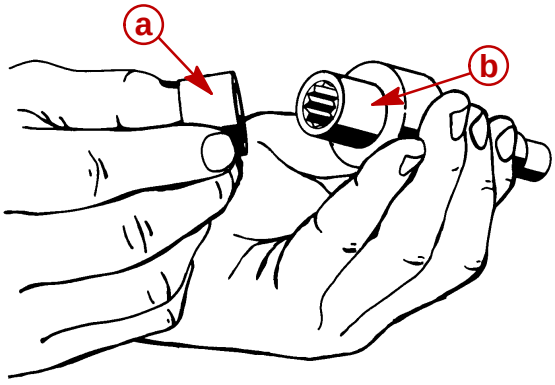
1. Install gimbal ring hinge pin bushings as follows:
   a. Install hinge pin into bearing and seal driver (P/N 91-43578A1).



22452

a - Hinge Pin
b - Deal Driver

   b. Apply Resiweld Sealer (92-65150-1) to O.D. of hinge pin bushing and position bushing on bearing and seal driver.



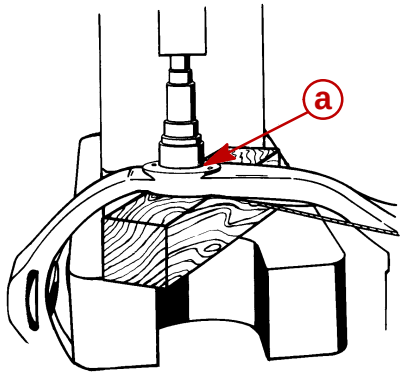
22440

a - Hinge Pin Bushing
b - Bearing and Seal Driver

Index

c. Inspect bore for cleanliness and damage before installing bushing.

d. Install bushing in each side of gimbal ring by pressing in place.

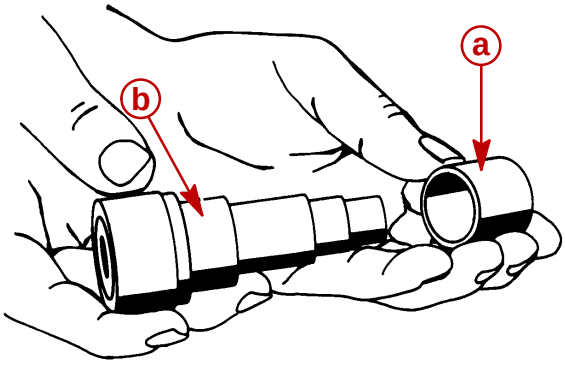


22454

a - Gimbal Ring

2. Install gimbal ring lower swivel pin bushing as follows:

a. Apply Resiweld Sealer (92-65150-1) to O.D. of bushing and position bushing on bearing and seal driver.



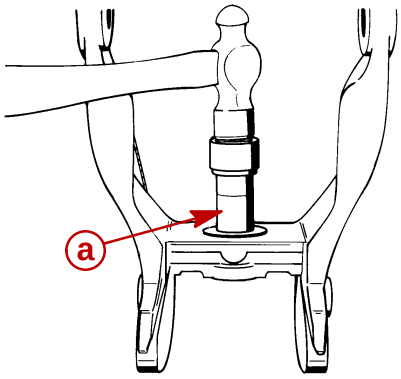
22440

a - O.D. of Bushing
b - Bearing and Seal Driver

b. Inspect bore for cleanliness and damage before installing bushing.

c. Install bushing in gimbal ring by pressing or tapping in place with a hammer.

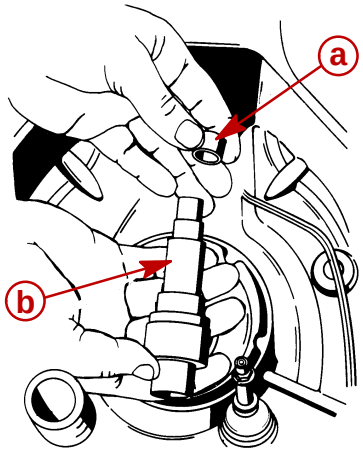
NOTE: *Pressing is preferred.*



22453

a - Bushing

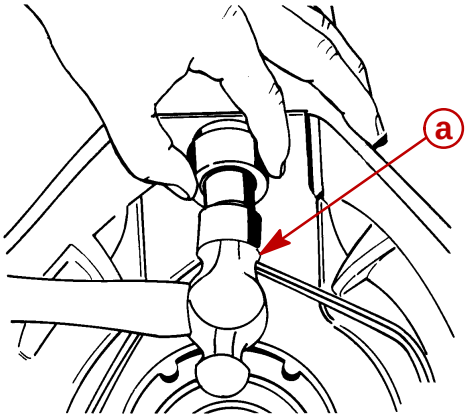
3. Install upper swivel shaft small bushing as follows:
   a. Place bushing on bearing and seal driver.



22440

a - Bushing
b - Bearing and Seal Driver

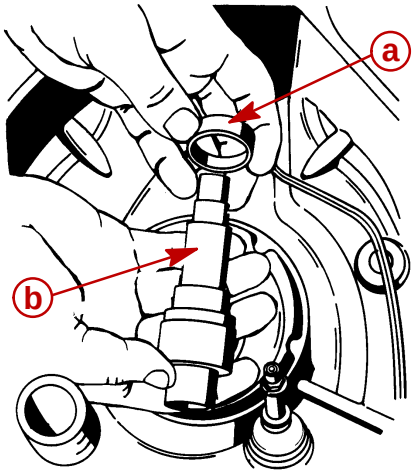
   b. Install bushing by tapping it in place with a hammer.



22450

a - Hammer

4. Install upper swivel shaft large bushing as follows:
   a. Place bushing on bearing and seal driver.

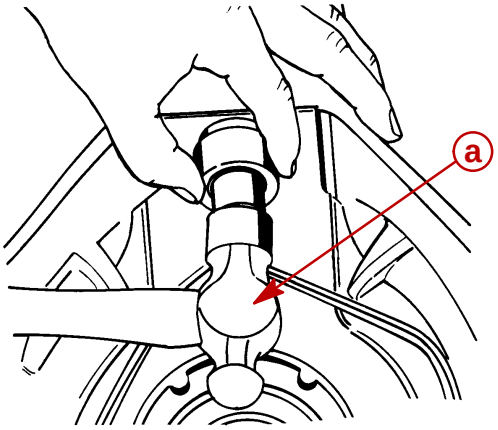


22436

a - Bushing
b - Bearing and Seal Driver

Index

b. Install bushing by tapping it in place with a hammer.

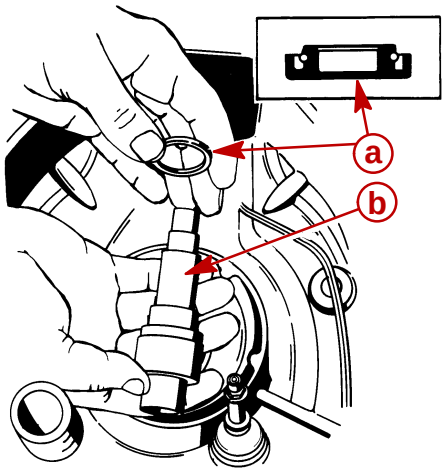


22450

a - Hammer

5. Install upper swivel shaft grease seal as follows:

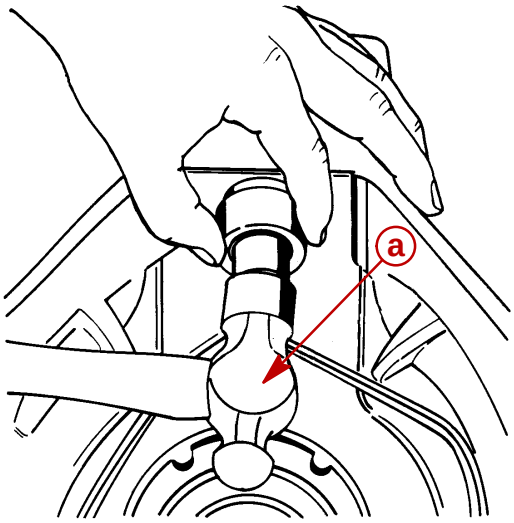
a. Place seal on bearing and seal driver with lip facing the small diameter end of tool. Apply Loctite 27131 to O.D. of seal.



22440

a - Seal
b - Bearing and Seal Driver

b. Install grease seal by tapping it in place with a hammer.



22450

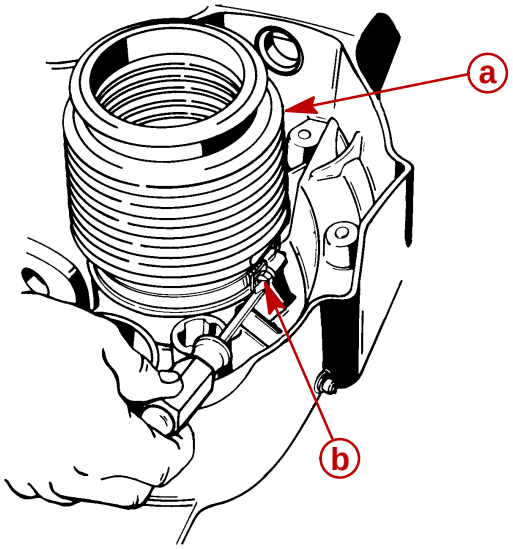
c - Hammer

Index

Gimbal Housing Servicing

U-joint Bellows Replacement

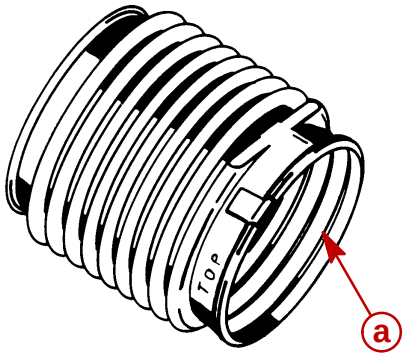
1. Remove U-joint bellows from gimbal housing.



50383

a - U-joint Bellows
b - Hose Clamp

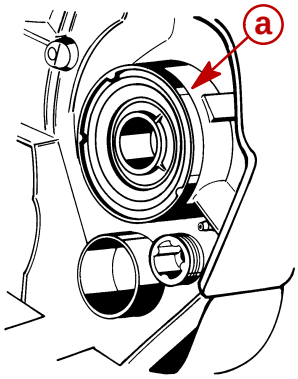
2. If reusing bellows, remove old adhesive from U-joint bellows using lacquer thinner.



50383

a - U-joint Bellows

3. Clean bellows mounting flange on gimbal housing with sandpaper and wipe clean with lacquer thinner.



22463

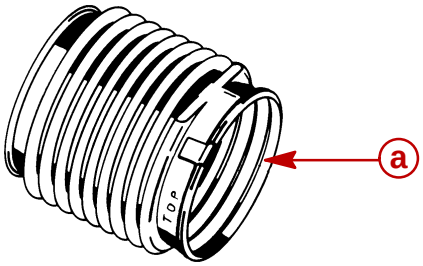
a - Mounting Flange

Index

⚠ WARNING

Be sure to read and follow package label direction when using bellows adhesive.

4. Apply bellows adhesive to inside diameter of bellows end that will be attached to gimbal housing. (Bellows adhesive IS NOT needed on the other end that connects to the bell housing.) Allow to dry (approximately 10 minutes), before installing.

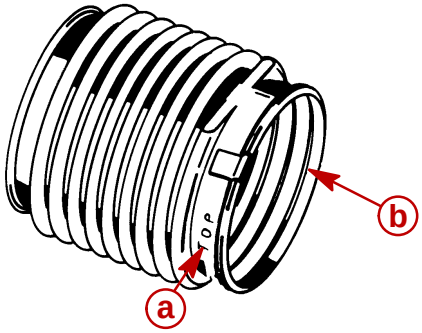


50383

a - Inside Diameter of Bellows End

IMPORTANT: "TOP" mark on U-joint bellows must be facing upward when installing bellows.

IMPORTANT: Ensure that the bead on the inner mating surface of bellows is positioned in the groove in gimbal housing flange.



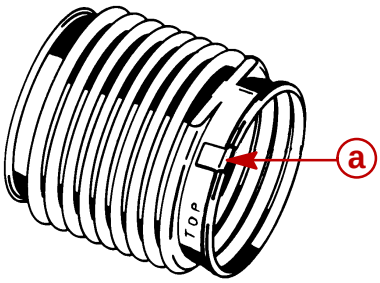
50383

a - "Top" Mark
b - Bead

⚠ CAUTION

Bellows clamp may corrode if ground clip is not installed.

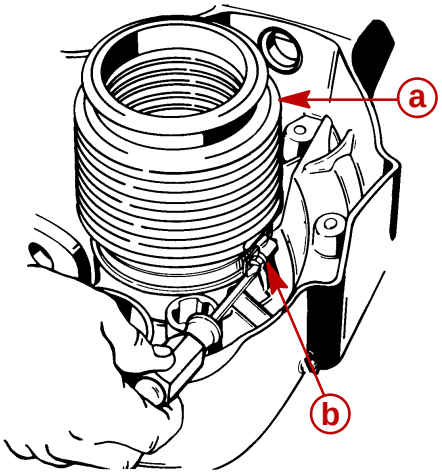
5. Position ground clip on bellows.



50383

a - Grounding Clip

6. Position U-joint bellows with “Top” mark facing upwards and install U-joint bellows on gimbal housing flange and position clamp as shown. Torque to 30-40 lb. in. (3.3-4.5 N·m).



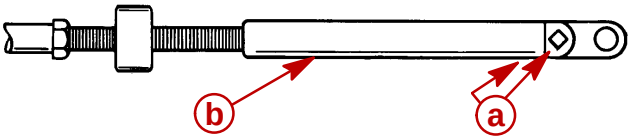
50383

a - U-joint Bellows
b - Hose Clamp - Torque to 30-40 lb. in. (3.3-4.5 N·m)

Shift Cable Bellows Replacement

1. Remove shift cable.

   a. Disconnect shift cable from shift plate and remove end guide.

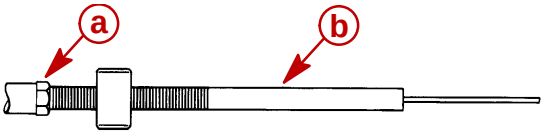


22183

a - Anchor Screws (2) - Loosen
b - End Guide

2. **Model with earlier style shift cable -** is identified by small nut which will not pass over cable anchor. Core wire must be pulled from shift cable to remove cable assembly from bell housing.

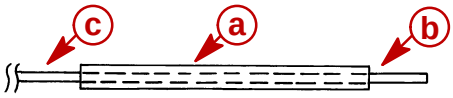
   a. Remove threaded tube.



22183

a - Jam Nut - Loosen
b - Threaded Tube

   b. Remove support tube and discard from core wire. Do not cut core wire, unless absolutely necessary.

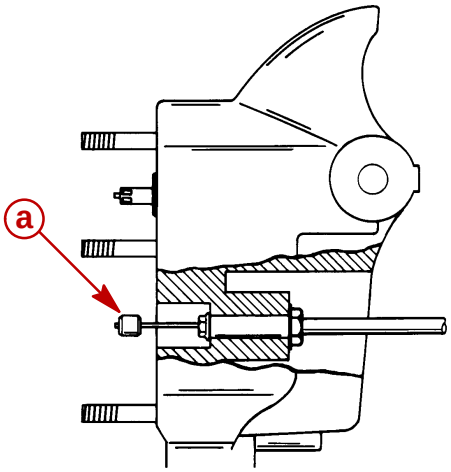


22183

a - Support Tube
b - Core Wire
c - Cut Here, If Absolutely Necessary

Index

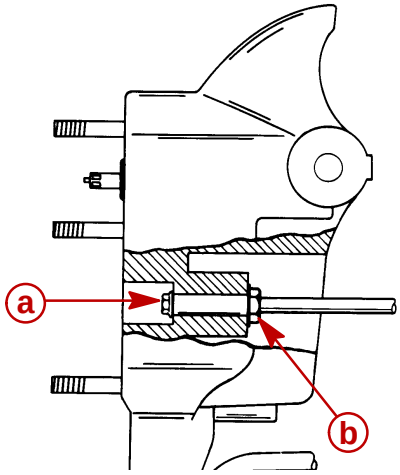
c. Remove inner core wire.



50327

a - Core Wire - Pull Out

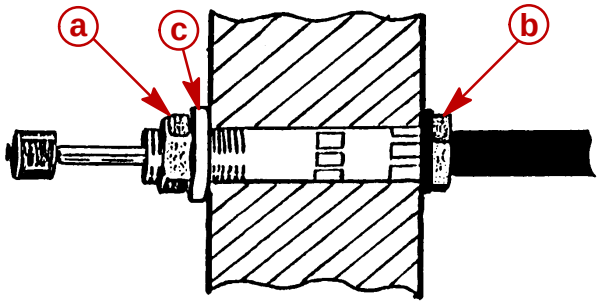
d. Remove shift cable retaining nut. Hold inside nut with wrench.



50327

a - Shift Cable Retaining Nut
b - Inside Nut

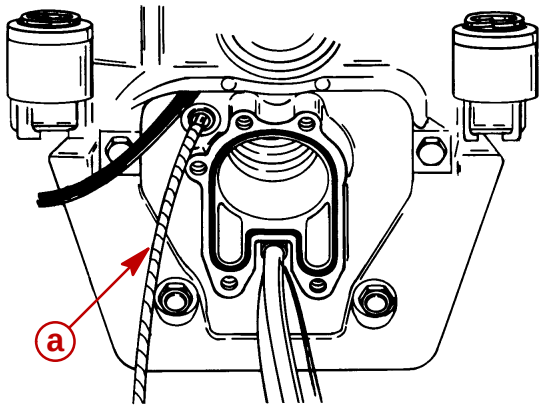
3. **Model with later style shift cable -** is identified by larger nut which fits over core wire anchor. It is unnecessary to remove core wire to remove shift cable assembly. Remove shift cable retaining nut and washer. Hold inside nut with wrench.



50323

a - Shift Cable Retaining Nut
b - Inside Nut
c - Washer

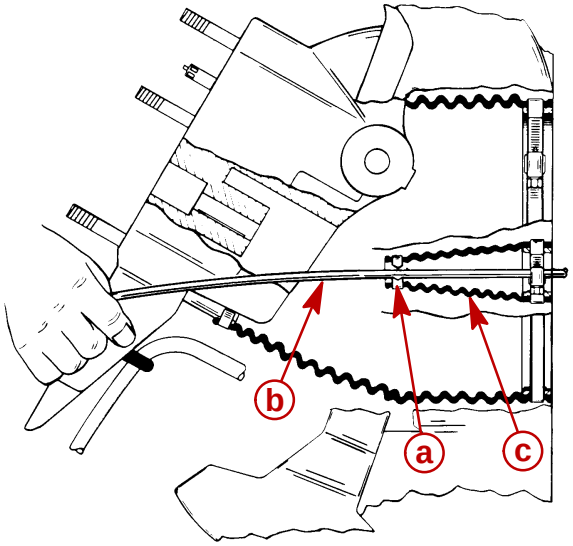
4. Remove shift cable wrapping.



22030

a - Shift Cable Wrapping

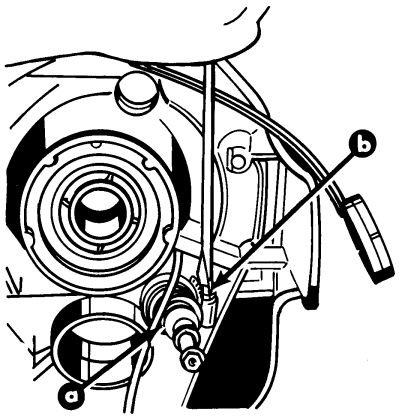
5. Loosen shift cable bellows crimp clamp, and pull shift cable, through shift cable bellows.



50458

a - Crimp Clamp
b - Shift Cable
c - Shift Cable Bellows

6. Remove shift cable bellows from gimbal housing.

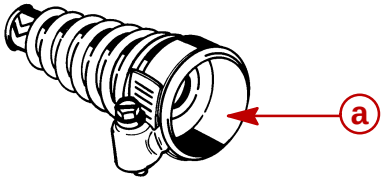


22460

a - Shift Cable Bellow
b - Hose Clamp

Index

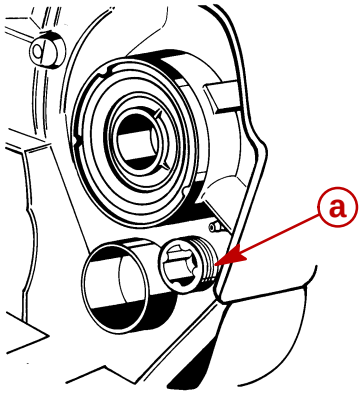
7. Remove old adhesive from shift cable bellows mounting surface using lacquer thinner.



22454

a - Shift Cable Bellows Mounting Surface

8. Clean shift cable bellows mounting flange on gimbal housing with sandpaper and wipe clean with lacquer thinner.



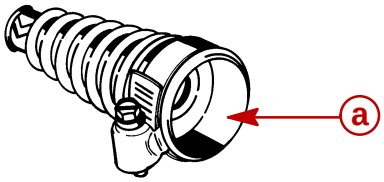
22463

a - Mounting Flange

⚠ WARNING

Read and follow package label directions before using bellows adhesive.

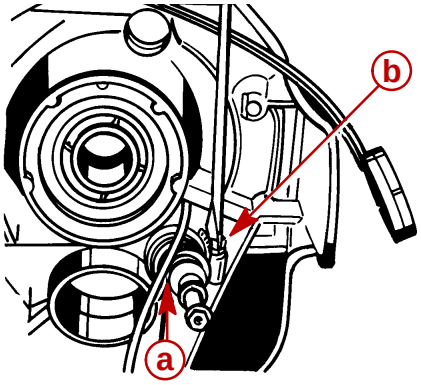
9. Apply bellows adhesive to shift cable bellows mounting surface. Allow to dry (approximately 10 minutes), before installing.



22454

a - Bellows Mounting Surface

10. Install shift cable bellows on gimbal housing flange. Position hose clamp as shown. Torque to 30-40 lb. in. (3.3-4.5 N·m).



22460

a - Shift Cable Bellows
b - Hose Clamp

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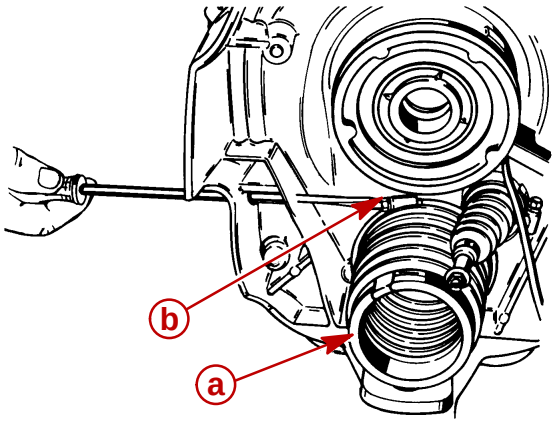
Exhaust Bellows Replacement

NOTE: *(For Exhaust Tube Replacement, see Section 4A)*

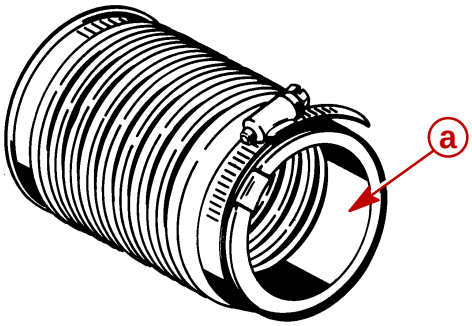
1. Remove exhaust bellows from gimbal housing.



22081

a - Exhaust Bellows
b - Hose Clamp

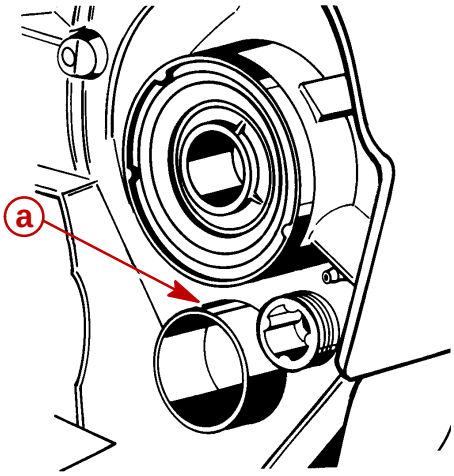
2. If old exhaust bellows will be reinstalled, remove old adhesive from exhaust bellows mounting surfaces, using lacquer thinner.



22450

a - Mounting Surface

3. Clean exhaust bellows mounting flange with sandpaper and wipe clean with lacquer thinner.



22463

a - Mounting Flange

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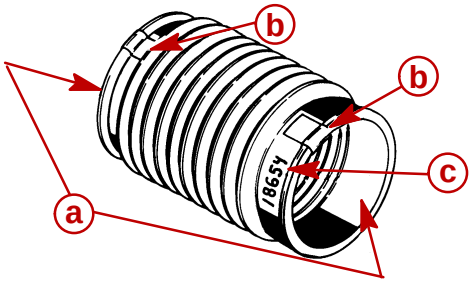
⚠ WARNING

Be sure to read and follow package label directions when using bellows adhesive.

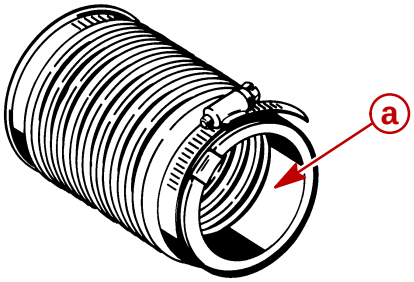
4. Position grounding clips on bellows. Use bellows P/N 18654, only. Do not substitute earlier model bellows.



22079

a - Apply Bellows Adhesive
b - Grounding Clips
c - Part Number - all replacement bellows should be P/N 18654. Do not use earlier model bellows.

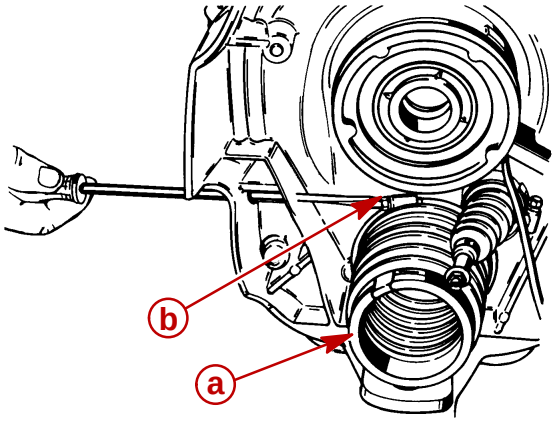
5. Apply bellows adhesive to exhaust bellows mounting surface. Allow to dry (approximately 10 minutes), before installing.



22450

a - Mounting Surface

6. Install exhaust bellows on gimbal housing flange. Position hose clamp as shown. Torque to 30-40 lb. in. (3.3-4.5 N·m).

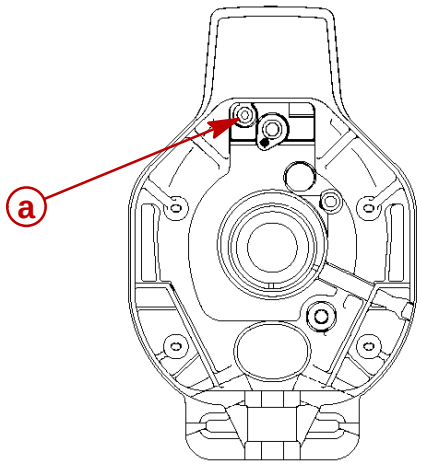


22081

a - Exhaust Bellows
b - Hose Clamp

Speedometer Hose Replacement

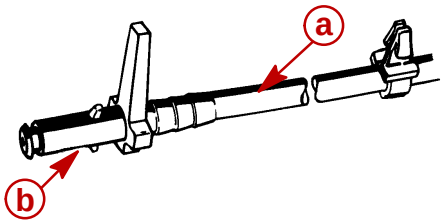
1. Remove hose clamp, if present, and remove outer speedometer hose from barbed fitting, by heating (low heat-hot water), and pulling off.



75979

a - Speedometer Hose Location

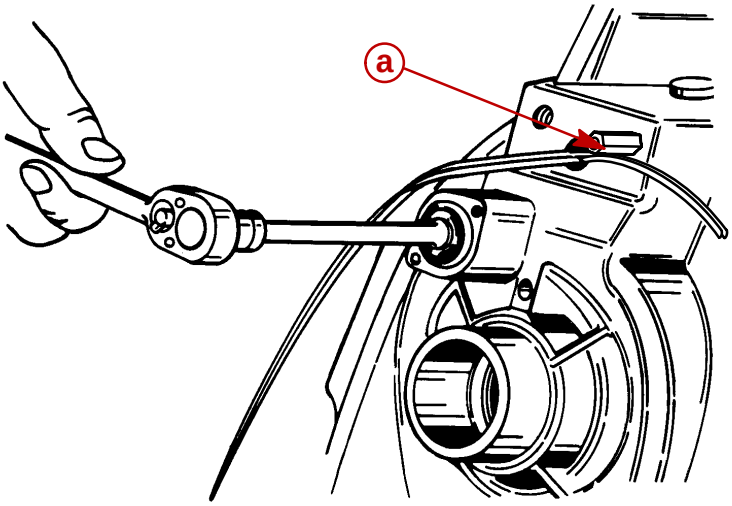
2. Remove hose from adaptor fitting by heating (low heat-hot water), and pulling off.



22461

a - Hose
b - Adaptor Fitting

3. Remove inner speedometer hose from barbed fitting by removing hose clamp and pulling hose off.

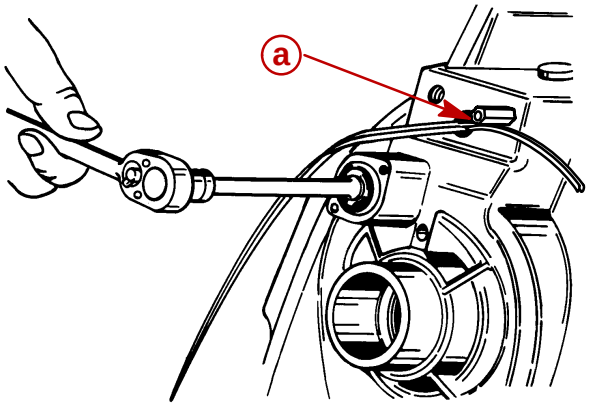


75962

a - Hose Clamp

Index

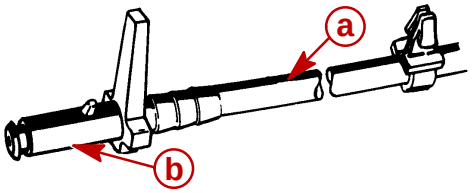
4. Install inner speedometer hose on barbed fitting. Secure with hose clamp. Torque to 30-40 lb. in. (3.3-4.5 N·m).



22492

a - Hose Clamp

5. Install outer speedometer hose on barbed fitting.
   a. Heat end of hose with low heat (hot water).
   b. Slip hose with hose clamp, over barbed fitting. As the hose cools, it will become tight on barbed fitting. Tighten hose clamp, securely.
6. Install adaptor fitting on speedometer hose.
   a. Heat end of hose using low heat. (Dip in hot water)
   b. Slip hose over adaptor fitting. As the hose cools, it will become tight on adaptor fitting.



22461

a - End of Hose
b - Adaptor Fitting

Gear Lube Monitor System Components

MONITOR TO THRU-BULKHEAD FITTING HOSE

Check hose periodically for condition, including cracks, hardening, etc.; replace as necessary.

1. To replace hose, remove hose clamps, and remove hose.
2. Install new hose of sufficient length to allow Monitor to be removed from topside or bottom side of bracket. Secure hose with hose clamps.
3. If thru-bulkhead fitting was taken out to remove gimbal housing, locknut (with washer) must be torqued to 12 lb. ft. (16 N·m); 90° hose barb compression fitting must be torqued to 70-90 lb. in. (8-10 N·m). Position of hose barb must be maintained, as shown.

IMPORTANT: Location of Monitor bracket is optional; if bracket is moved, installation must not cause hose (when routed) to interfere with the movement of the power steering assembly or engine coupler. MINIMUM HEIGHT OF INSTALLATION: bottom of bracket must be no lower than the top surface of the fibre washers upon wh the engine mounts set.

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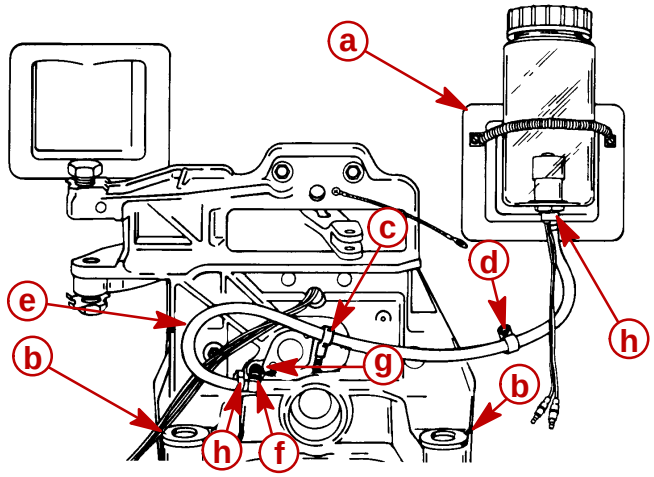
NOTE: *If location does not require that the connecting hose crosses the inner transom plate to port side, the J-clip on water pickup outlet (top bolt) would neither be needed nor installed. The plastic hose clip can be used to hold hose in position, if needed, on transom, and prevent it from contacting the power steering assembly or engine coupler, after they are installed.*

4. If bracket is being mounted port side, attach seawater outlet and gasket, with J-clip under top bolt, at location shown. Do not mount where any component will interfere with power steering assembly, when installed. If mounting bracket on starboard side, do not use or attach J-clip.



50364

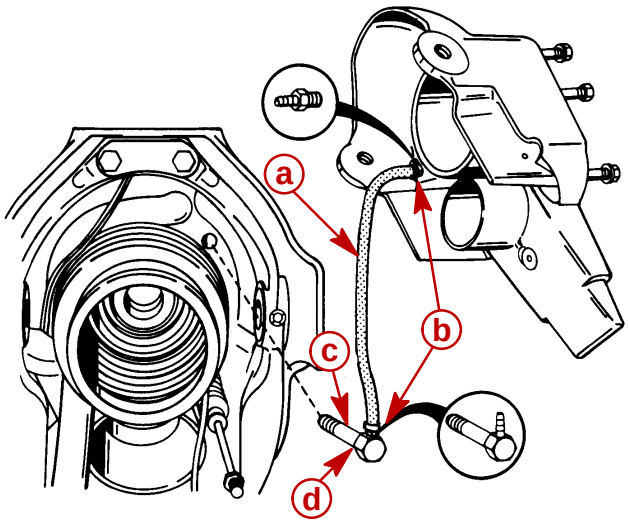
a - Monitor Bracket
b - Fiber Washers
c - J-clip (install at this location, if used)
d - Plastic Hose Clip
e - Connecting Hose
f - 90° Hose Barb Compression Fitting
g - Locknut and Washer
h - Hose Clamp

IMPORTANT: After installation of replacement hose, check that hose will not contact any part of the power steering assembly or engine coupler.

THRU-BULKHEAD TO BELL HOUSING GEAR LUBE MONITOR HOSE

NOTE: *Bell housing must be removed from gimbal ring for this procedure (see Section 4B-10).*

1. Remove hose clamps, and remove hose.
2. Replace hose and hose clamps; tighten hose clamps securely (hose and clamps are installed on bell housing hose barb and thru-bulkhead fitting, **before** thru-bulkhead fitting is reinstalled).



50337

a - Hose
b - Hose Clamps
c - Thru-Bulkhead Fitting
d - O-ring Seal (not shown)

BELL HOUSING TO DRIVESHAFT HOUSING CHECK VALVES

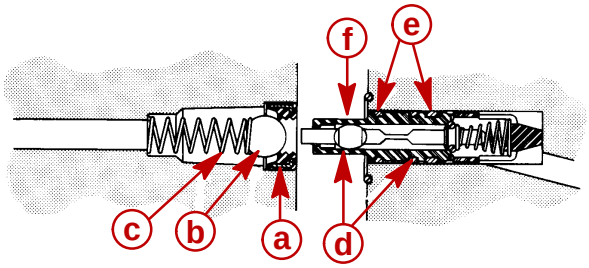
Unless damaged during disassembly, or by heat, these check valves should last the life of the drive unit.

The bell housing check valve is replaced as an assembly.

Removal

1. The bell housing check valve can be removed with pliers, and discarded, or it can be removed by placing hose clamp snugly over area “f,” and pulling out, with pliers on hose clamp, and reinstalled if working properly.

2. The driveshaft housing check valve can be removed by retracting the seal cup with a pliers or hook, and discarded. Remove the check valve and spring, and discard.

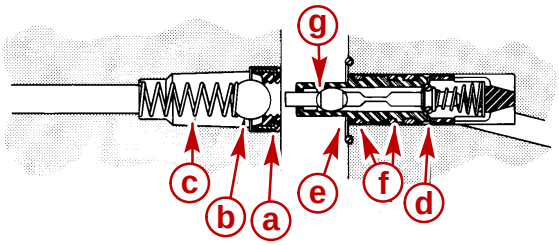


50321

a - Seal Cup
b - Check Ball
c - Spring
d - Check Valve Assembly
e - O-rings (2)
f - Area to Secure Hose Clamp for Retraction

Reassembly

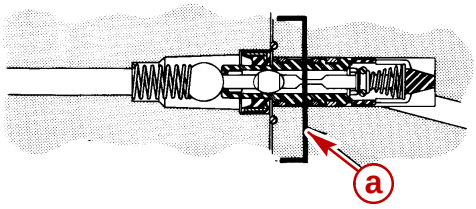
1. **Driveshaft Housing -** insert spring, check ball, and seal cup - press or tap, carefully, on seal cup until outer face is flush with casting surface, as shown. Do not use sealant.
2. **Bell Housing -** coat O-rings with Gear Lube; insert check valve assembly into passage-way, place 3/8 in. deep wall socket over valve end, and tap into casting until shoulder surface “e” is flush with casting surface.



50321

a - Seal Cup
b - Check Ball
c - Spring
d - Bell Housing Check Valve Assembly
e - This Surface Must Be Flush with Casting
f - O-rings (2)
g - Valve End

3. After units are connected, and drive unit and Gear Lube Monitor are filled with Gear Lube, check area “a,” and under bottom seam of mating surfaces, for oil leak. Recheck for oil leak after first use.



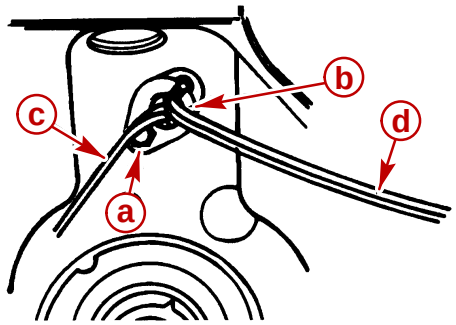
50321

a - Check for Oil Leak

Index

Trim Position Sender and Trim Limit Switch Wire Replacement

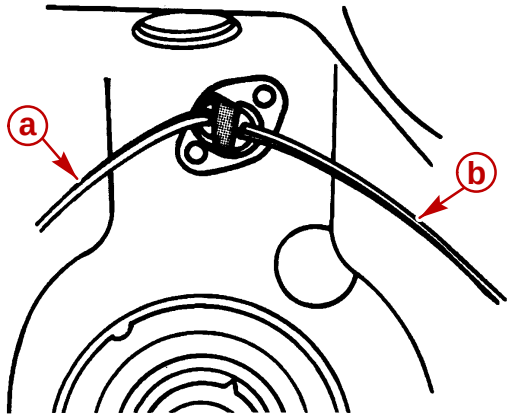
1. Remove trim limit switch wires and trim position sender wires.



70197

a - Screw
b - Trim Harness Clamp - Remove
c - Trim Limit Switch Wires
d - Trim Position Sender Wires

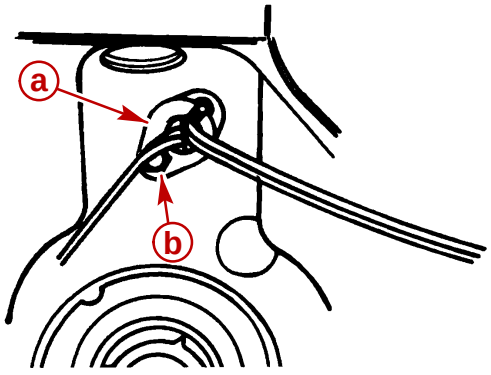
2. Install trim limit switch wires and trim position sender wires. DO NOT pinch wires.



70198

a - Trim Limit Switch Wires
b - Trim Position Sender Wires

3. Apply Perfect Seal to threads of screw and install trim harness clamp, and screw.

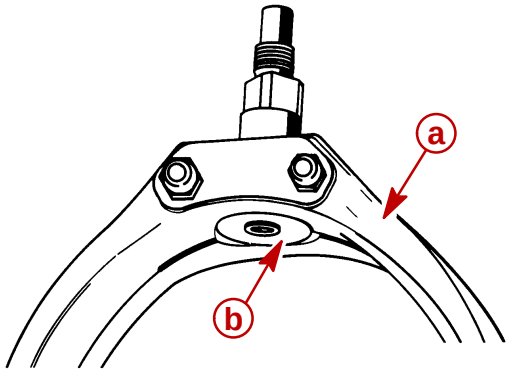


70197

a - Trim Harness Clamp
b - Screw

Gimbal Ring/Swivel Shaft/and Steering Lever Installation

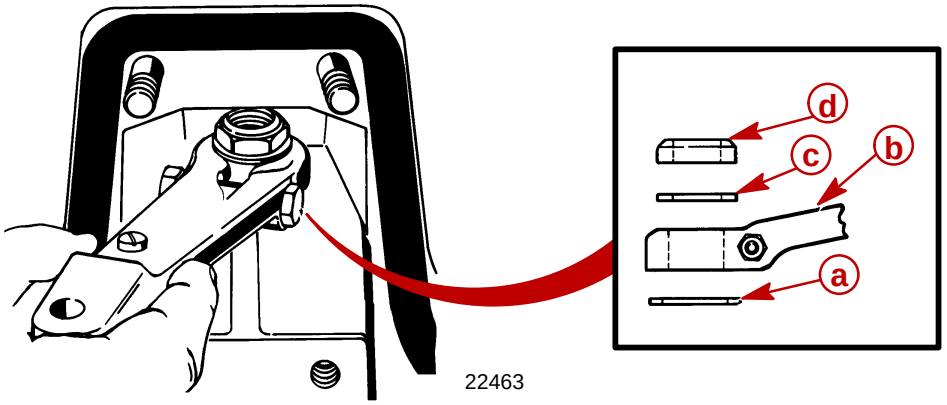
1. If installing new upper swivel shaft or gimbal ring, ensure that upper swivel shaft fits all the way into gimbal ring. Shoulder on shaft must bottom out against ring. If necessary, clean up mating surfaces with a file.



22436

a - Gimbal Ring
b - Upper Swivel Shaft - Flange Must Bottom Out Against Gimbal Ring

2. Place large I.D. washer, steering lever, small I.D. washer, and locknut into steering lever cavity in gimbal housing.



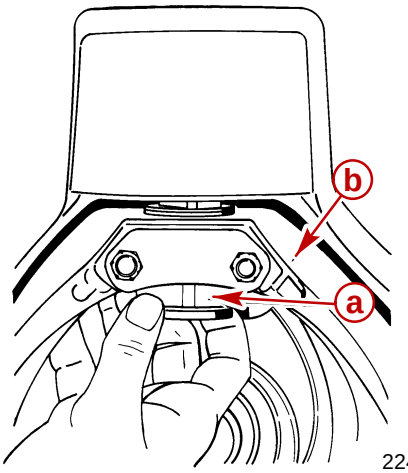
22463

22492

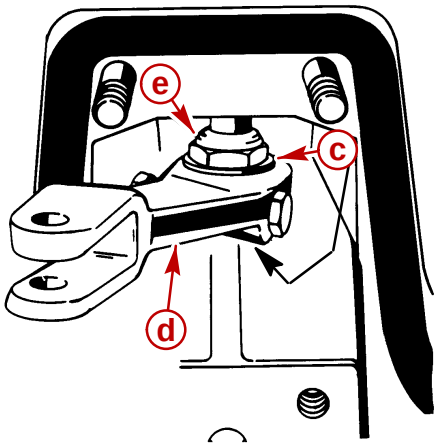
a - Large I.D. Washer
b - Steering Lever
c - Small I.D. Washer
d - Locknut

Index

3. Install upper swivel shaft through gimbal ring and up into and through washers, steering lever and locknut. Start locknut on upper swivel shaft threads. DO NOT tighten at this time.



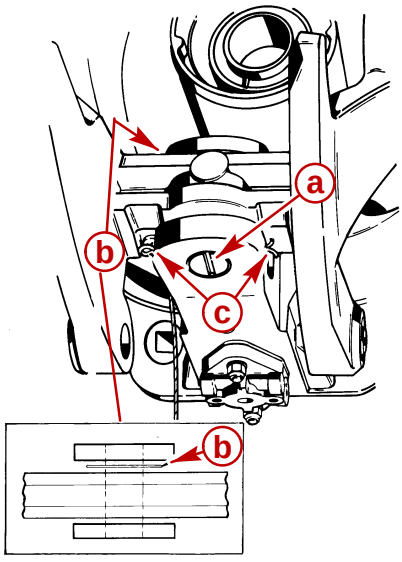
22452



22463

a - Upper Swivel Shaft
b - Gimbal Ring
c - Washers
d - Steering Lever
e - Locknut

4. Install lower swivel pin, washer, and secure with cotter pin. Spread ends.

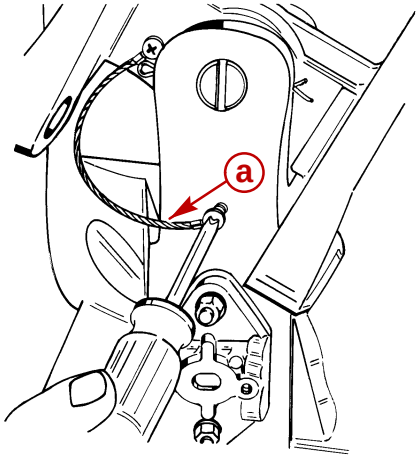


22461

22445

a - Swivel Pin
b - Washer
c - Cotter Pin

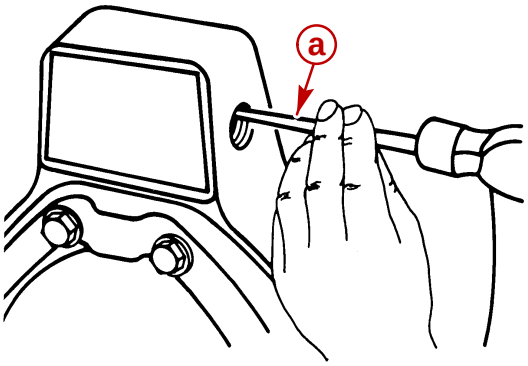
5. Connect ground wire from gimbal housing to gimbal ring, after cleaning ground wire ring terminal and screw. Tighten securely.



22261

a - Ground Wire

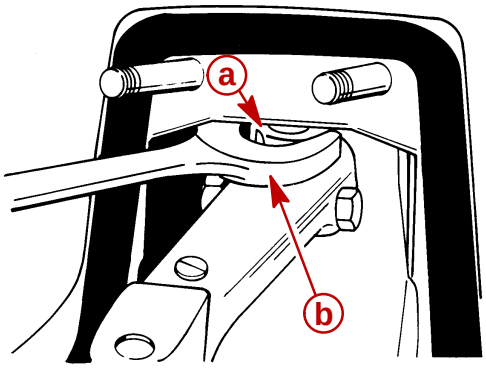
6. Tighten locknut until a clearance of .002 - .010 in. (0.05 - 0.25 mm) exists between lower swivel pin washer and gimbal housing mount.



70156

Engine And Transom Assembly Installed

a - Pin Punch



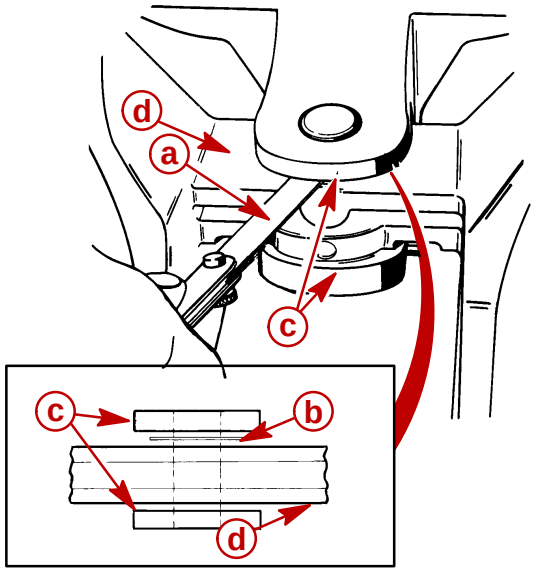
22452

Engine And Transom Assembly Removed

a - Locknut
b - 1-1/16 in. Wrench

Index

7. Strike down on gimbal ring flanges using a rawhide mallet. Recheck clearance and tighten locknut as necessary.

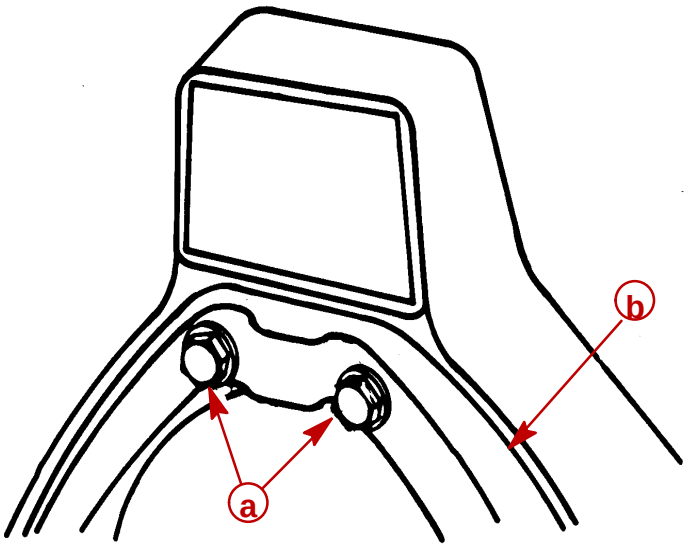


22461

22445

a - Feeler Gauge - .001 - .010 in. (0.05 - 0.25mm)
b - Washer
c - Gimbal Housing Mount
d - Gimbal Ring

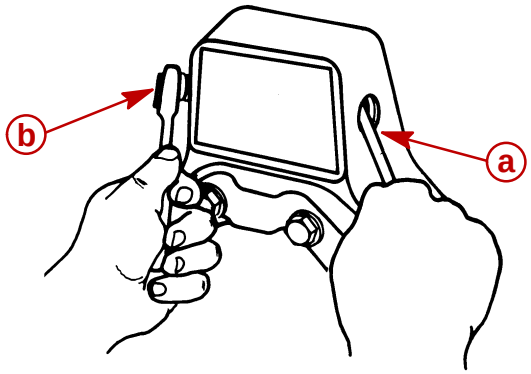
8. Torque U-bolt nuts evenly to 50-55 lb. ft. (67-74 N·m).



70150

a - Screws (2) and Washers (2) Nuts (2) (not seen)
b - Gimbal Ring

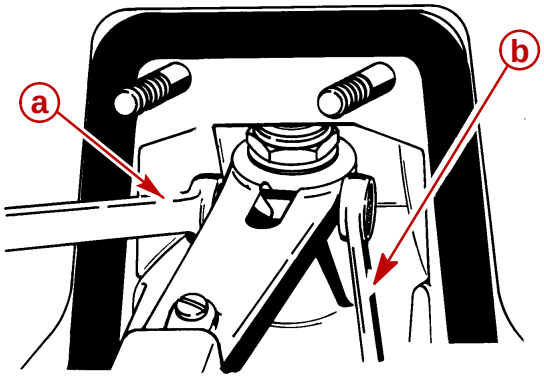
9. Tighten steering lever clamping bolt and nut. Torque 45-55 lb. ft. (61-74 N·m).



70157

Engine And Transom Assembly Installed

a - Wrench
b - Socket Wrench

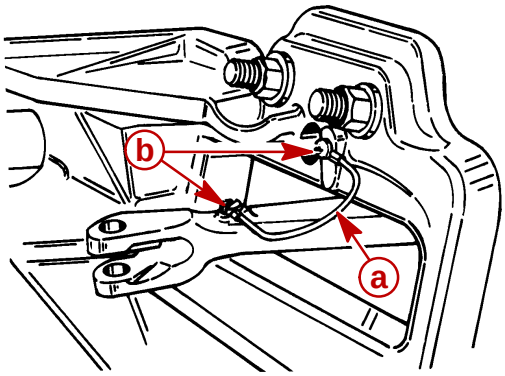


22460

Engine And Transom Assembly Removed

a - Wrench
b - Wrench

10. Install steering lever ground wire. Wire must be positioned as shown. Tighten securely.



22028

a - Ground Wire
b - Screws - Tighten Securely

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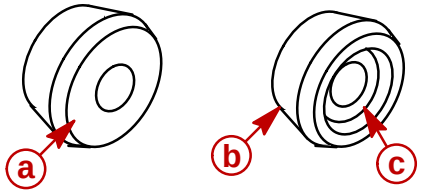
IMPORTANT: If equipped with "Trim-In-Limit Blocks", refer to Section 5B before installing trim cylinders on gimbal ring.

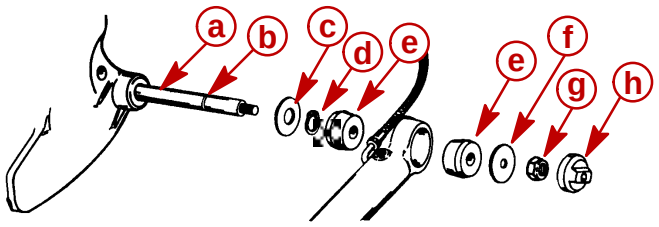
NOTE: *The bushings on Later Bravo drive units are made from a different type of material. The later style is harder. The bushing can also be identified by a small indentation on the outside face of the bushing. Do not mix the earlier style rubber bushings with the later style.*



75271

a - Earlier Style Bushing
b - Later Style Bushing
c - Indentation on Later Style

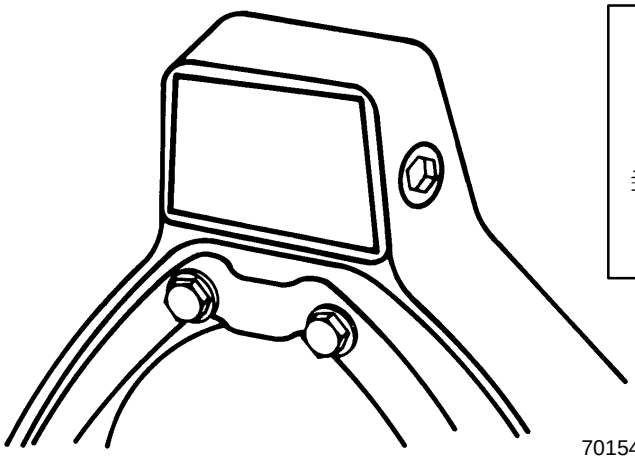
11. Install trim cylinders on gimbal ring.



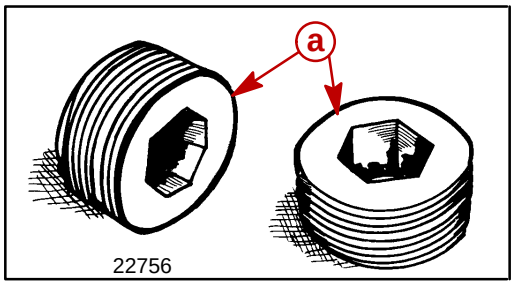
71489

a - Anchor Pin (1)
b - Slots (2)
c - Flat Washer (Large I.D.) (2)
d - Snap Rings (2)
e - Rubber Bushings (4)
f - Flat Washer (Small I.D.) (2)
g - Locknut (2)
h - Plastic Cap (2)

12. Coat threads of plastic plugs (if used) with Perfect Seal and thread into access hole until flush with housing. Use a 5/8 in. hex wrench or 5/8 in. hex stock to secure.



70154



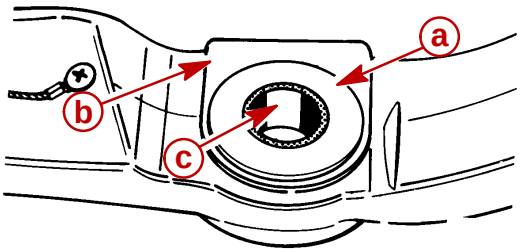
22756

a - Plastic Plugs

13. Touch up any bare metal spots with primer and "Phantom Black" spray paint.

Bell Housing Installation

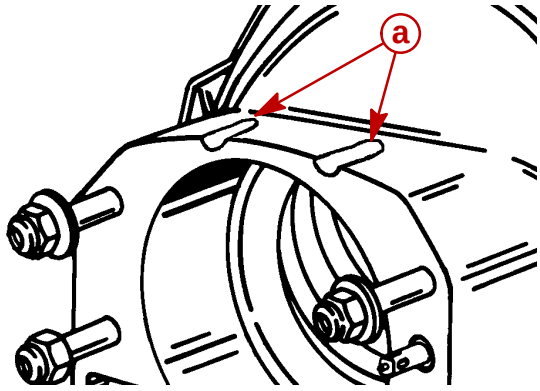
1. **On Standard Transom Assembly -** Install fiber washers on gimbal ring. Secure with Resiweld Sealer (92-65150-1) (Epoxy). Ensure that washer pilots on hinge pin bushing.



22454

a - Fiber Washers - Glue in Place
b - Gimbal Ring
c - Hinge Pin Bushing

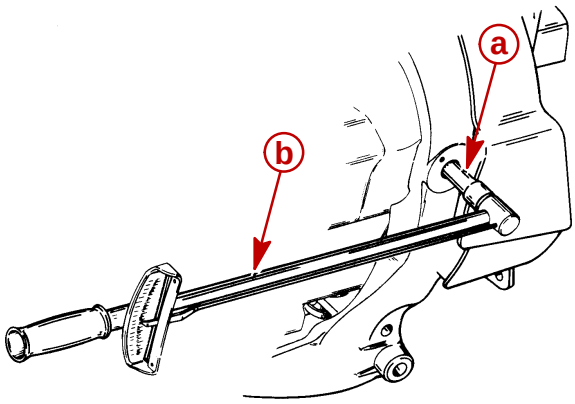
NOTE: *If drive shaft housing is equipped with Trim-In Limit Pins, the bell housing shown in the following illustration must be used. There are two indentations in the top aft edge of the bell housing. These indentations help prevent scratching of the top side of the bell housing by the gimbal ring U-bolt, when the trim-in limit pin is positioned in the aft position (Refer to Sec. 5B for Trim-In Limit Pin Information.)*



75258

a - Indentations

2. **On Standard Transom Assembly -** Install bell housing. Clean threads and apply Loctite 27131 to threads of hinge pins (Port and Starboard). Install hinge pins and torque to 140-150 lb. ft. (190-203 N·m).



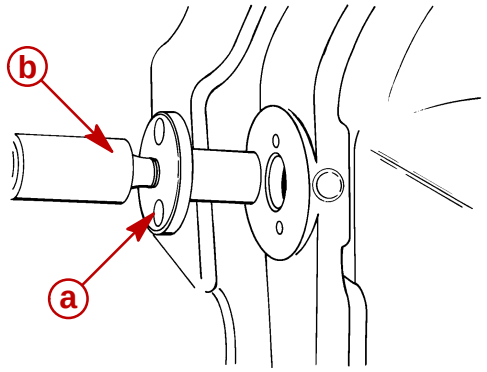
22113

a - Hinge Pin Tool (91-78310)
b - Torque Wrench

Index

3. **On High Performance Transom Assembly -** Install hinge pins using special tool (91-63616) and slide hammer as follows:

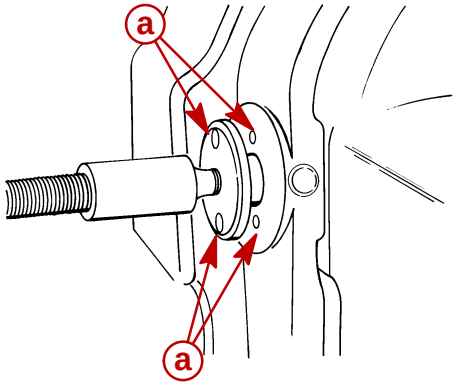
   a. Thread hinge pin onto special tool. Lubricate hinge pins with Quicksilver Special Lubricant 101.



71828

a - Hinge Pin
b - Special Tool

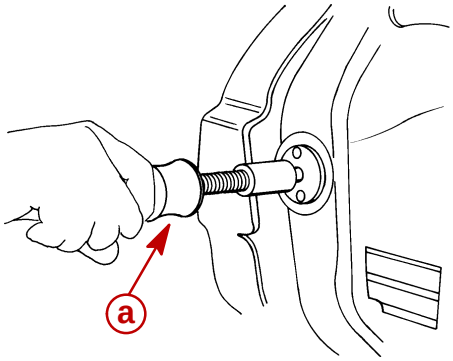
   b. Slide hinge pin through gimbal ring and bell housing. Be sure to align screw holes in hinge pin with holes in gimbal ring.



71827

a - Screw Holes

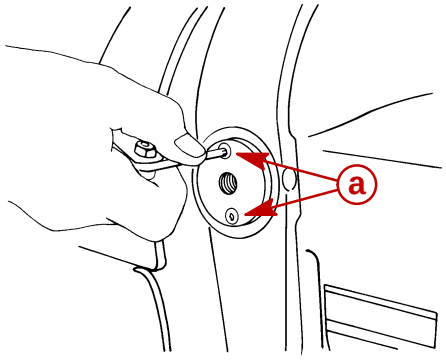
   c. Lightly tap hinge pin into place using slide hammer.



71826

a - Slide Hammer

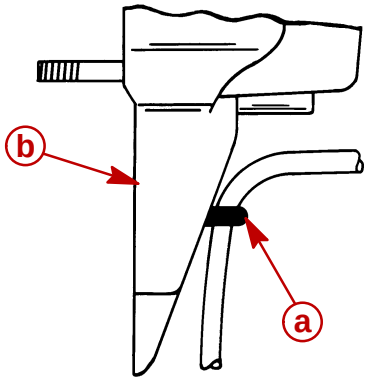
d. Apply Loctite 242 to threads of screws and install. Torque screws to 25-30 lb.in. (2.8-3.3 N·m).



71825

a - Screws

4. Install speedometer hose clip onto bell housing.



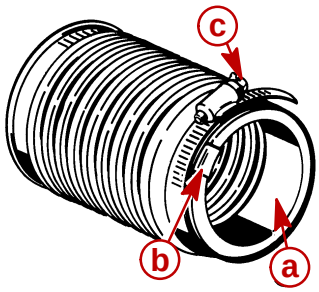
22121

a - Speedometer Hose Clip
b - Bell Housing

⚠ WARNING

Be sure to read and follow package label directions when using bellows adhesive.

5. Install exhaust bellows on bell housing as follows:
   a. Clean exhaust bellows mounting flange on bell housing with sandpaper and wipe clean with lacquer thinner.
   b. Apply bellows adhesive to mounting surface on inside of bellows.
   c. Position grounding clip on bellows.
   d. Place hose clamp over bellows end.

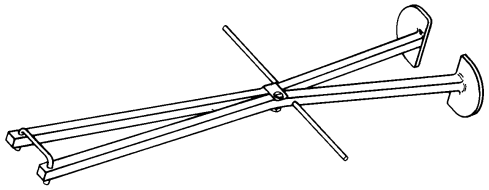


22450

a - Mounting Surface
b - Grounding Clip
c - Hose Clamp

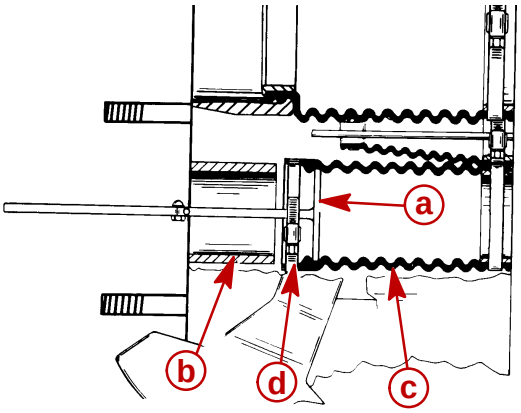
Index

e. Place bellows expander tool (91-45497A1) into first bellows convolution.



22161

f. Pull tool until tool touches the mounting flange on bell housing (bellows starts to slip onto flange); then release tool.



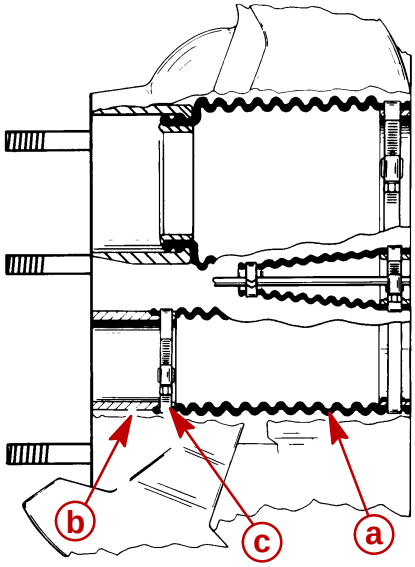
22116

a - Expander Tool (91-45497A1)
b - Bell Housing Flange
c - Exhaust Bellows
d - Hose Clamp

g. Reposition tool into the third bellows convolution.

h. Pull bellows onto bell housing flange.

i. Tighten hose clamp. Torque to 30-40 lb. in. (3.3-4.5 N·m). Remove tool.

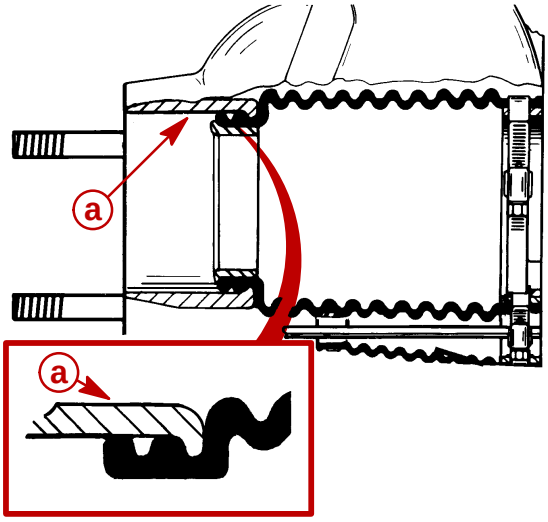


22116

a - Exhaust Bellows
b - Bell Housing Flange
c - Hose Clamp - Tighten Securely

6. Install U-joint bellows on bell housing as follows:

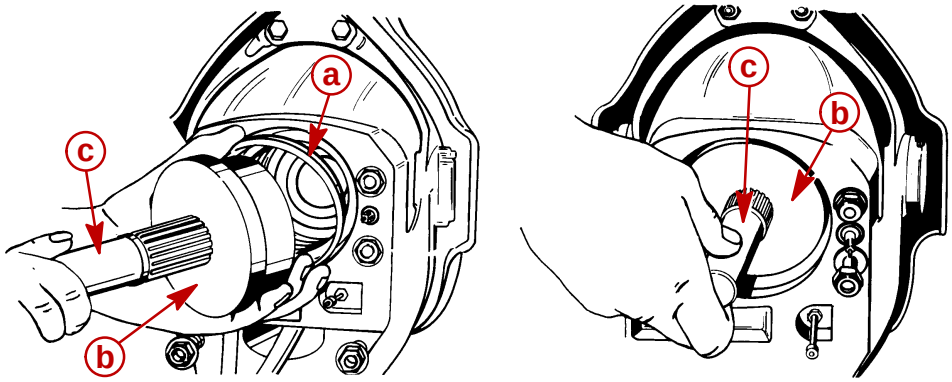
   a. Position U-joint bellows on bell housing. Ensure that the bell housing flange (a) rests in the second groove from the end of bellows.



22116

a - Bell Housing Flange

   b. Lubricate sleeve O.D. with water or engine cleaner and install sleeve installation tool and a suitable driving rod.

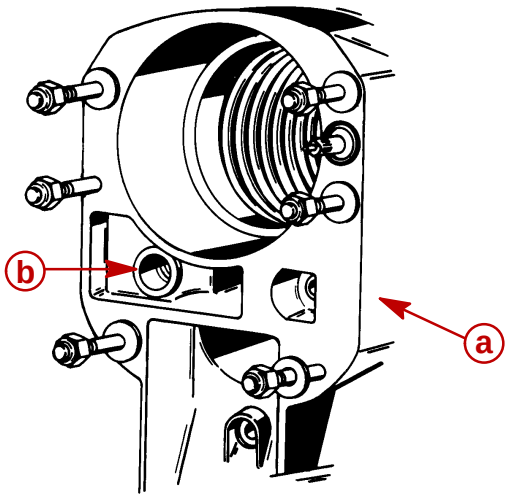


50327

a - Sleeve
b - Sleeve Installation Tool (91-43577)
c - Suitable Driving Rod

7. Install water hose on bell housing as follows:

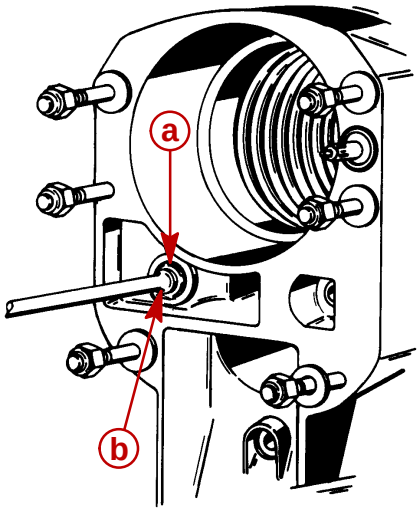
   a. Position hose so that approximately 1/8 in. (3mm) protrudes from edge of opening.



50322

a - Bell Housing
b - Water Hose

   b. Apply a small amount of 2-4-C Marine Lubricant with Teflon to hose I.D. and install tapered inserts using the tapered insert tool (91-43579).



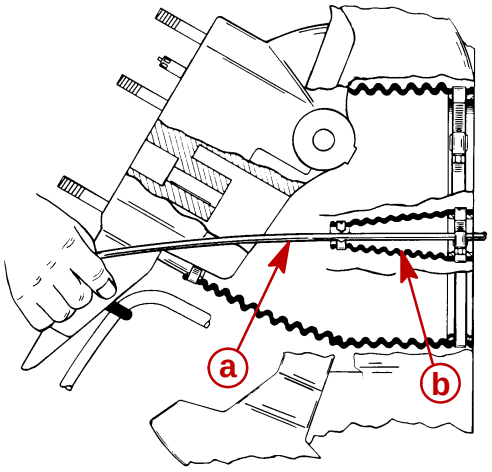
50322

a - Tapered Insert
b - Tapered Insert Tool (P/N 91-43579)

Shift Cable Installation

If replacing core wire in shift cable refer to section 4A.

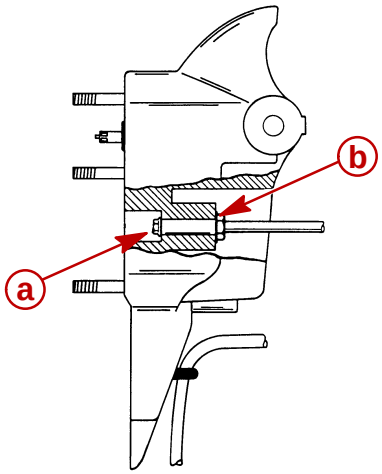
1. Insert shift cable end into and through shift cable bellows.



50458

a - Shift Cable End
b - Shift Bellows

2. Apply Perfect Seal to shift cable retaining nut threads. Secure shift cable to bell housing.

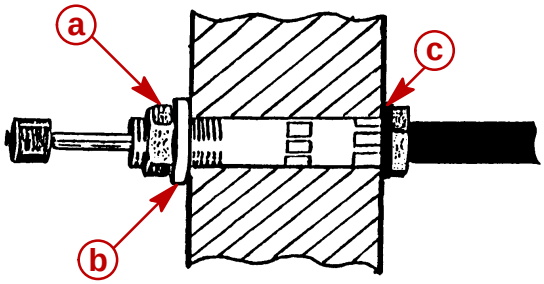


50327

Earlier Style Cable (Core Wire Removed)

a - Shift Cable Retaining Nut - Apply Perfect Seal To Threads Of Nut
b - Seal

LATER STYLE CABLE - Is identified by larger nut which fits over core wire anchor. It is unnecessary to remove core wire to remove/install shift cable assembly.



50323

a - Shift Cable Retaining Nut - Apply Perfect Seal To Threads Of Nut
b - Washer
c - Seal

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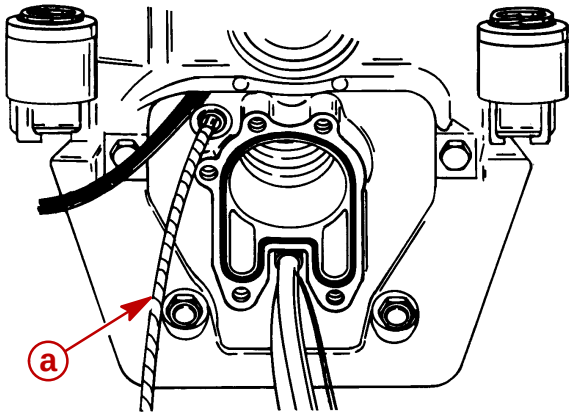
3. Install shift cable wrapping.

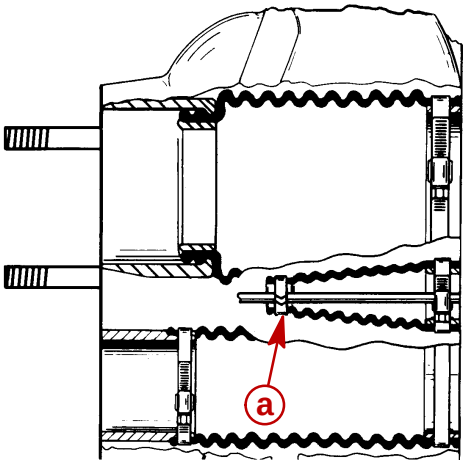


22030

a - Shift Cable Wrapping

Check that bellows end is not flattened out when crimping in the following step. Water leakage may result if clamp is not installed properly.

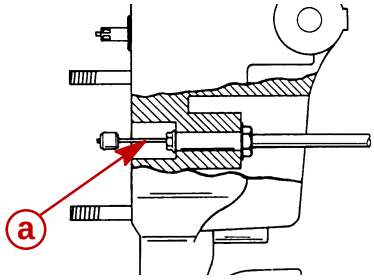
4. Install and compress shift cable bellows crimp clamp, maintaining a 1/2 in. diameter round O.D. Be sure that clamp is crimped evenly so that a good seal is maintained between bellows and shift cable. Do not allow bellows to flatten.



22117

a - Crimp Clamp

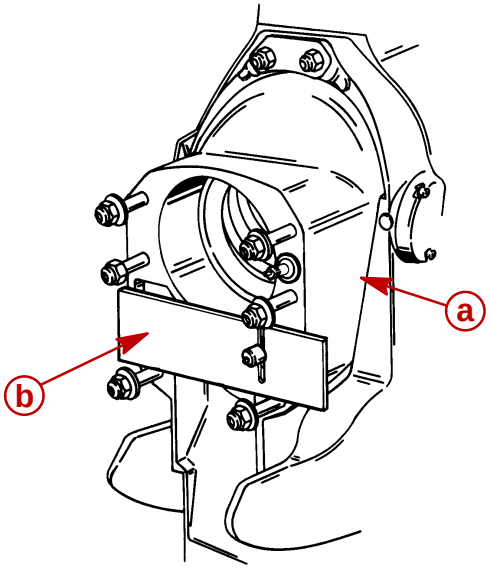
5. **Models With Earlier Shift Cable -** Install inner core wire.



50327

a - Inner Core Wire

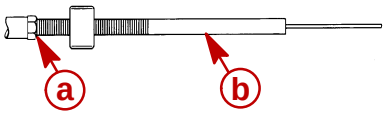
6. Install core wire locating tool (P/N 91-17263) on face of bell housing.



50327

a - Bell Housing
b - Core Wire Locating Tool (P/N 91-17263)

7. Install threaded tube until it bottoms. Tighten finger tight. Secure jam nut.

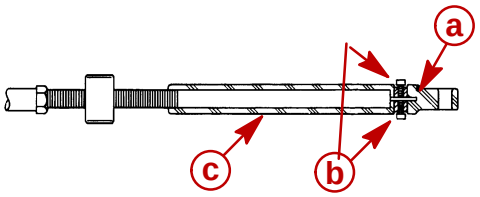


22183

a - Threaded Tube
b - Jam Nut - Tighten Securely

8. **Earlier shift cables with support tubes -** discard support tube; do not reinstall.

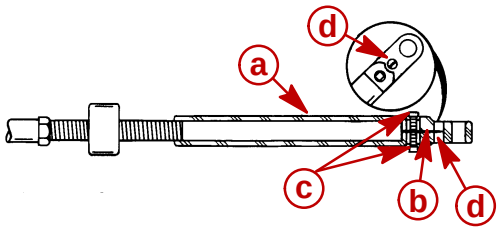
10. Install cable end guide over core wire, and insert core wire through cable anchor. Tighten anchor screws evenly.



22183

Earlier Models

a - Core Wire
b - Anchor or Screws - Torque to 20 lb. in. (2.3 N·m)
c - Cable End Guide



22183

Later Models

a - Cable End Guide
b - Core Wire
c - Anchor Screws - Torque to 20 lb. in. (2.3 N·m)
d - Sight Port - bottom-out core wire (present on all later style and some earlier style cables)

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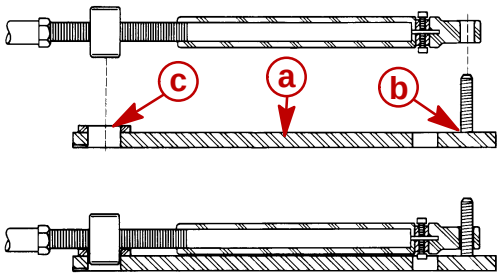
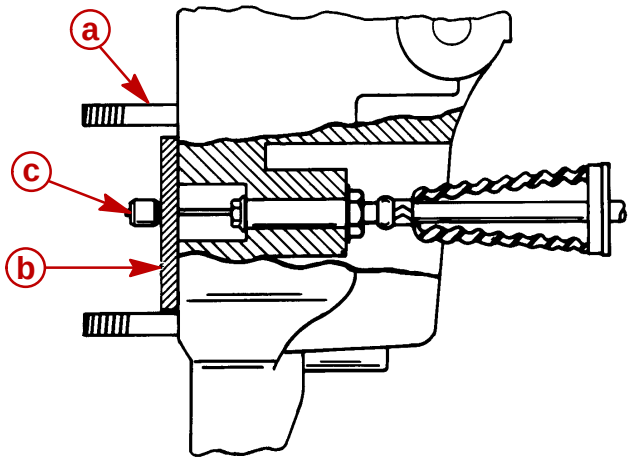
11. Place shift cable anchor adjustment tool (P/N 91-17262) on end of shift cable as shown.



22120

a - Shift Cable Anchor Adjustment Tool (91-17262)
b - Stud - Placed through Hole in End Guide
c - Hole - Barrel Placed Here

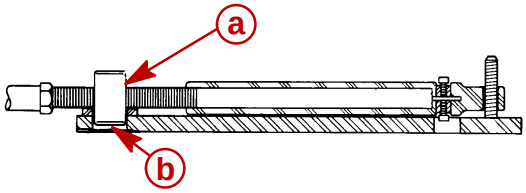
12. Ensure that bell housing end of core wire is positioned tight against core wire locating tool.



22121

a - Bell Housing
b - Core Wire Locating Tool
c - Core Wire

13. Adjust cable barrel to align with hole in tool. Remove tools.

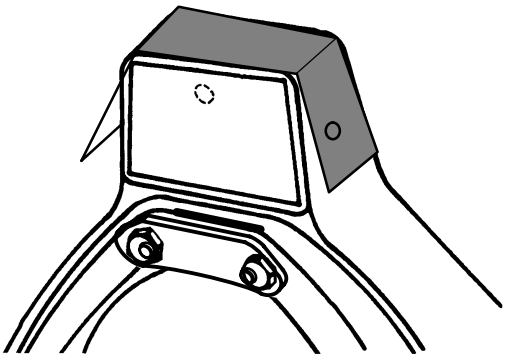


22120

a - Barrel
b - Hole in Tool

Bravo Access Plug Drilling Template

IMPORTANT: Carefully cut-out template - use straightedge to make accurate folds. Align centerline of template with centerline of dimple or grease fitting (on older models). With template accurately aligned, TAPE TEMPLATE TO GIMBAL HOUSING, securely, so that it cannot move or shift.



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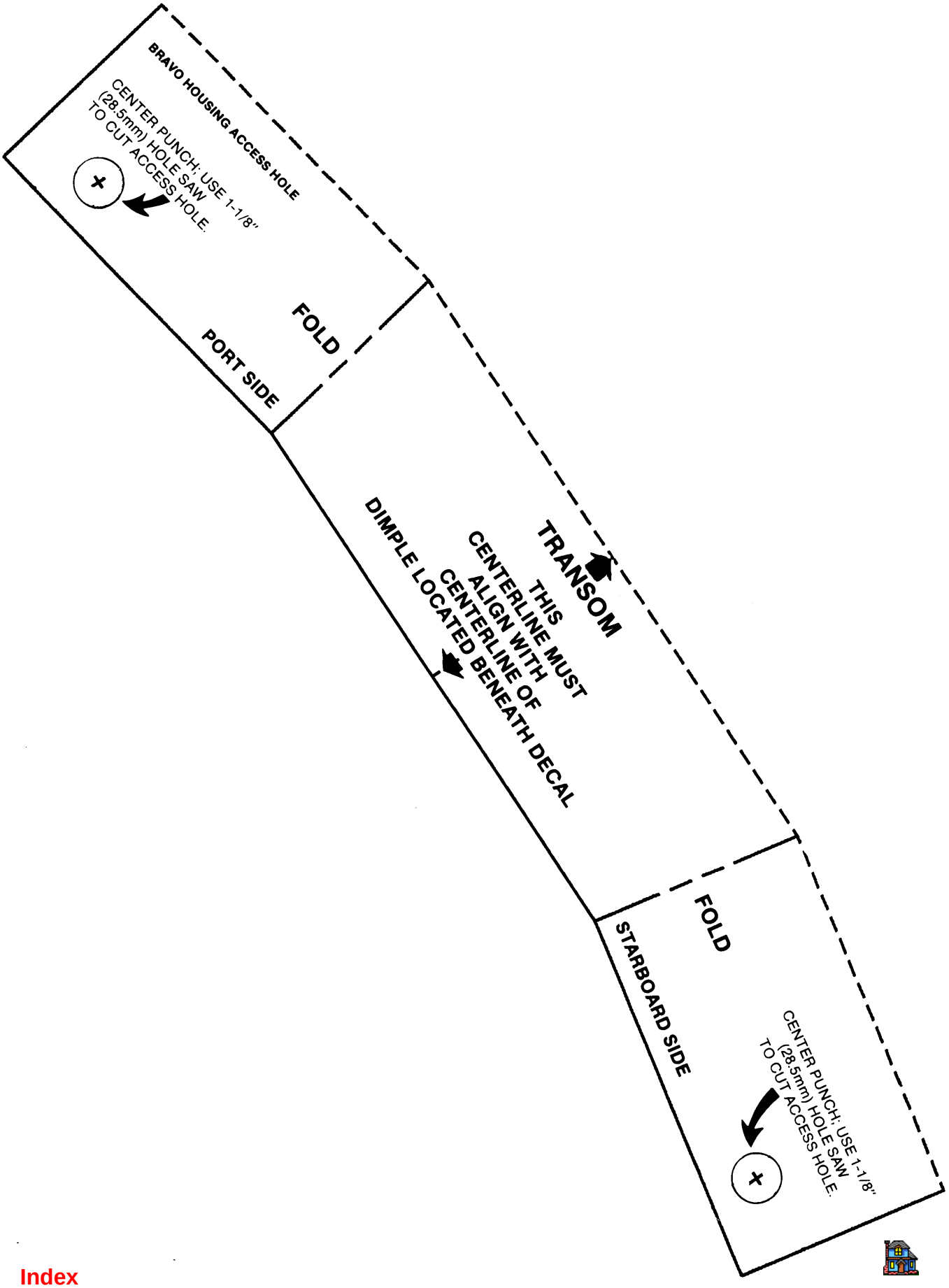
BRAVO HOUSING ACCESS HOLE
CENTER PUNCH; USE 1-1/8" (28.5mm) HOLE SAW TO CUT ACCESS HOLE.
FOLD
PORT SIDE
TRANSOM
THIS CENTERLINE MUST ALIGN WITH CENTERLINE OF DIMPLE LOCATED BENEATH DECAL
FOLD
STARBOARD SIDE
CENTER PUNCH; USE 1-1/8" (28.5mm) HOLE SAW TO CUT ACCESS HOLE.

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POWER TRIM

Section 5A - Oildyne Trim Pump

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5 A

Trim Pump Specifications

Valve Pressure Specifications

VALVE	PRESSURE	
	PSI	kPa
Up Circuit	2200-2600	15173-17932
Down Circuit	400-600	2759-4138

Electrical Specification

PUMP AMPERAGE DRAW	PRESSURE	
	PSI	kPa
115 Amps at:	2200-2600	15173-17932

Torque Specification

DESCRIPTION	TORQUE		
	lb. in.	lb. ft.	N·m
Up Pressure Relief Valve	70		7.9
Down Pressure Relief Valve	70		7.9
Thermal Relief Valve	70		7.9
Pump-to-Adaptor Mounting Screws	70		7.9
Motor-to-Adaptor Mounting Screws	25		2.8
Hex Plug Retainers		38-50	51-67
UP Pressure Hydraulic Hose (Black)	110		12
DOWN Pressure Hydraulic Hose (Gray)	110		12

Special Tools

DESCRIPTION	PART NUMBER
Trim Pump Test Gauge Kit	91-52915A6
Torque Wrench (lb. in.)	91-66274

Lubricants/Adhesives/Sealers

DESCRIPTION	PART NUMBER
Quicksilver Power Trim and Steering Fluid	92-90100A1
Quicksilver 2-4-C Marine Lubricant with Teflon	92-825407A12
Liquid Neoprene	92-25711-2

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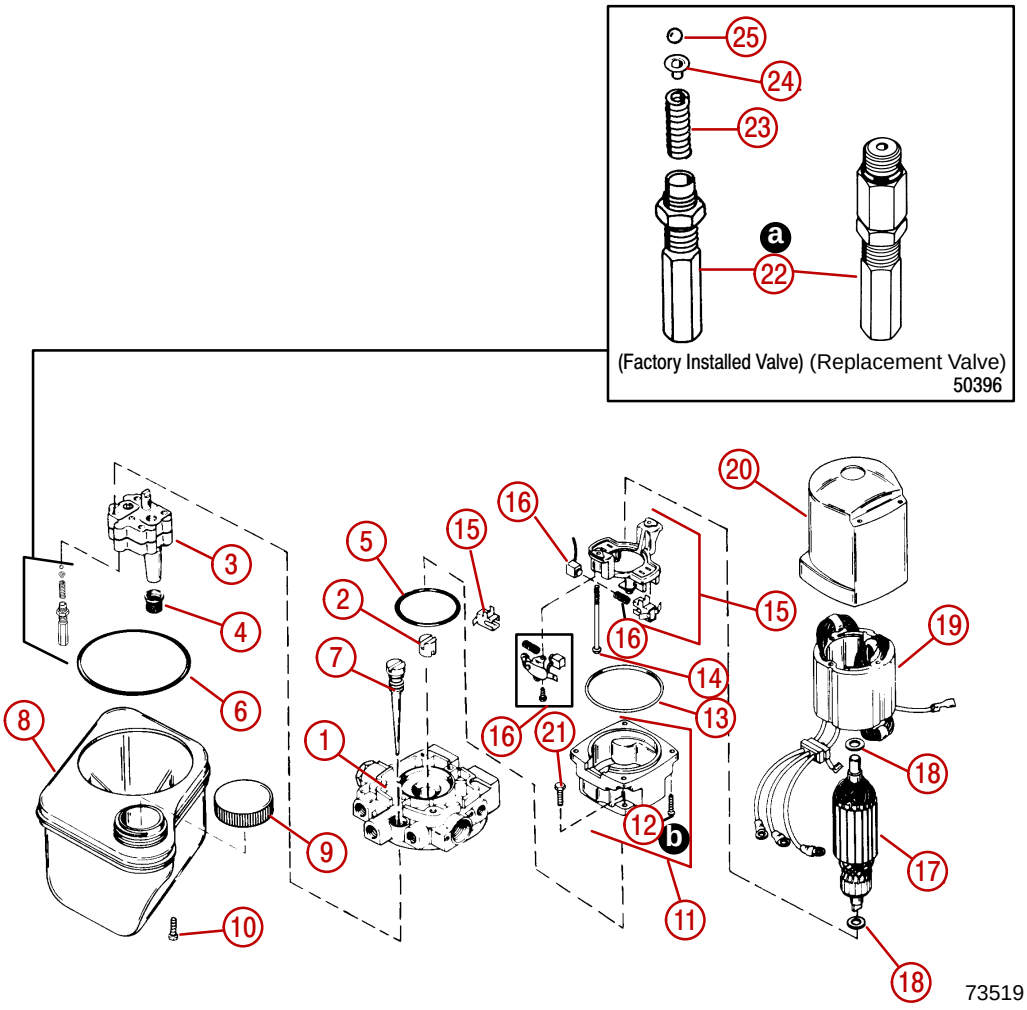
Trim Pump Exploded View

Oildyne Trim Pump



1 - Adaptor
2 - Coupling
3 - Pump
4 - Filter
5 - O-ring-Motor End
6 - O-ring, Reservoir End
7 - Dipstick
8 - Reservoir
9 - Cap (With Vent Hole)
10- Screw (Includes O-ring)
11- End Cap w/Bearing Screw
12- Screw
13- O-ring
14- Screw
15- Brush Holder Kit
16- Brush set
17- Armature
18- Thrust Washer
19- Field and Frame
20- Housing
21- Screw
22- Relief Valve With:
23- Spring
24- Eyelet
25- Check Ball

Replacement Relief Valve Color Code:

Down Pressure: Green

Up Pressure: Blue

Thermal: Gold

Torque Specifications

ⓐ 75 lb. in. (8 N·m)

ⓑ 25 lb. in. (2.8 N·m)

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Maintaining Power Trim Pump Oil Level

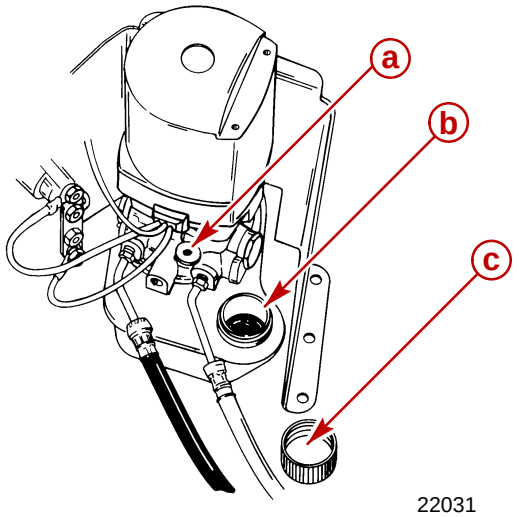
⚠ CAUTION

Avoid pump damage. Vent reservoir pressure by backing out the vent screw two turns after tightening completely. Units without a vent screw have a vented fill cap. Remove the fill neck seal on models without a vent screw.

IMPORTANT: Check the oil level with the stern drive unit in the full down position.

IMPORTANT: If quicksilver Power Trim and steering fluid is not available, SAE 10W-30 or 10W-40 engine oil can be used in the system.

1. Remove the fill cap, the raise and lower the drive unit 6 to 10 times to purge air from the system. Check the oil level visually.
2. If there is a vent screw, it must be backed out 2 full turns. If there is no vent screw, remove the fill neck seal to vent the pump.
3. Maintain the oil level between the “Max” and “Min” marks on the side of the reservoir. Fill to the bottom lip on the fill neck.



22031

a - Vent Screw
b - Bottom Lip on the Fill Neck
c - Vent Hole

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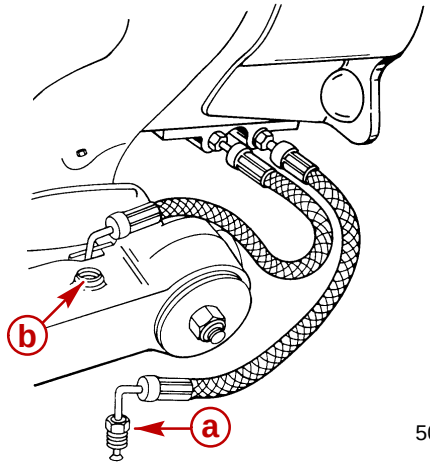
Air Bleeding Power Trim System

1. The Power Trim System will purge itself of a small amount of air by raising and lowering the drive unit several times. However, if a rebuilt trim cylinder is being installed (which has not been filled with oil), the following bleeding procedure should be used to remove the air from the system.

Bleeding OUT/UP Trim Circuit

1. Fill the pump reservoir to the proper level as explained preceding. (The trim cylinder must be compressed.)
2. Disconnect the OUT/UP hose from the front connection on the trim cylinder. If both cylinders were rebuilt, disconnect the hoses from both cylinders.
3. Direct the end of the trim hoses(s) into a container.
4. Run the trim pump in the UP direction until a solid, air-free stream of fluid is expelled from the hose(s). Reconnect the hose(s) and tighten securely.
5. Refill the trim pump to the proper level.

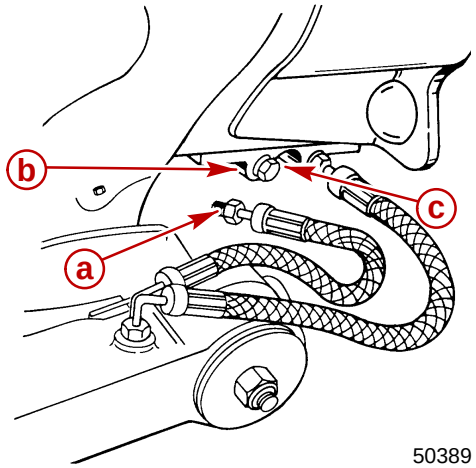


50389

a - OUT/UP Trim Hose
b - Front Connection On Trim Cylinder

Bleeding IN/DOWN Trim Circuit

1. Ensure that the pump reservoir is filled to the proper level.
2. Disconnect the IN/DOWN hose from the rear connection on the gimbal housing hydraulic connector. If both cylinders were rebuilt, disconnect the hoses from both sides of the hydraulic connector.
3. Plug the holes in the hydraulic connector, using a plug (22-38609) or suitable device.
4. Direct the end of the trim hose(s) into a container.
5. Run the trim pump in the Up direction until the trim cylinders are fully extended.
6. Remove the plug(s) from the gimbal housing hydraulic connector and momentarily run the trim pump in the IN/DOWN direction until a solid, air-free stream of fluid is expelled from the rear hole(s) in the hydraulic connector. Reconnect the trim hose(s) and tighten securely.
7. Lower the drive unit to the full IN/DOWN position and refill the trim pump to the proper level. Run the trim system IN/DOWN and OUT/UP several times and recheck the fluid level.



50389

a - In/“Down Trim Hose
b - Hydraulic Connector
c - Plug (22-38609)

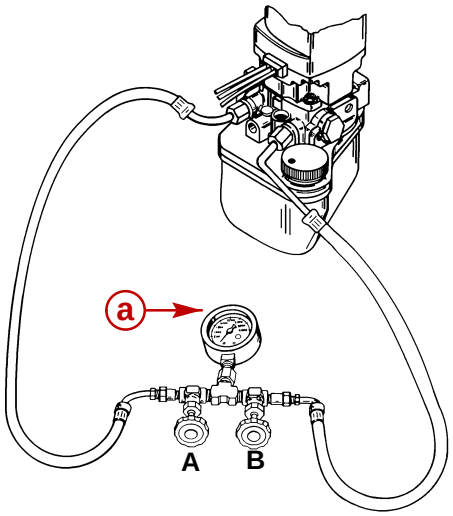
Testing Power Trim Pump

⚠ CAUTION

Cross connecting trim hoses will damage the stern drive housing. Appropriately mark trim hoses and hose connections to ensure proper reassembly.

Test Gauge

1. Check the trim pump oil level. Fill if necessary.
2. Place the drive unit in the full IN/DOWN position.
3. Connect the test gauge at the most convenient location (at pump or hydraulic connector).



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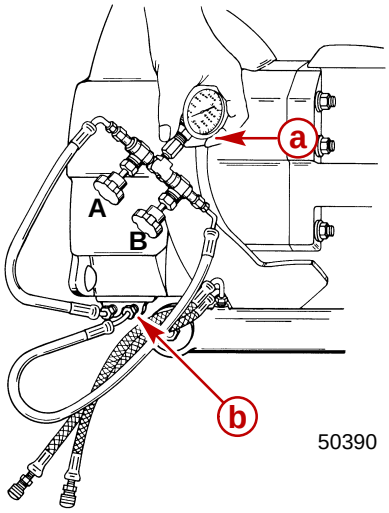
Gauge Connected to Pump

a - Hydraulic Test Gauge (91-52915A6)



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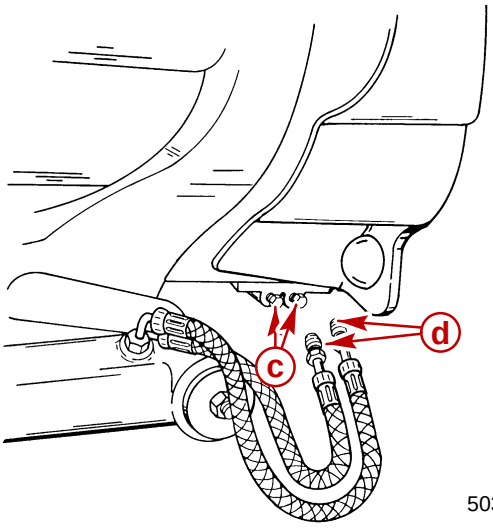

50391

Gauge Connected to Hydraulic Connector

a - Hydraulic Test Gauge (91-52915A6)
b - Gimbal Housing Hydraulic Connector
c - Caps (Supplied with Gauge)
d - Plugs (Supplied with Gauge)

4. Open valve “A” and “B” and run the pump UP and DOWN several times (to pu air).

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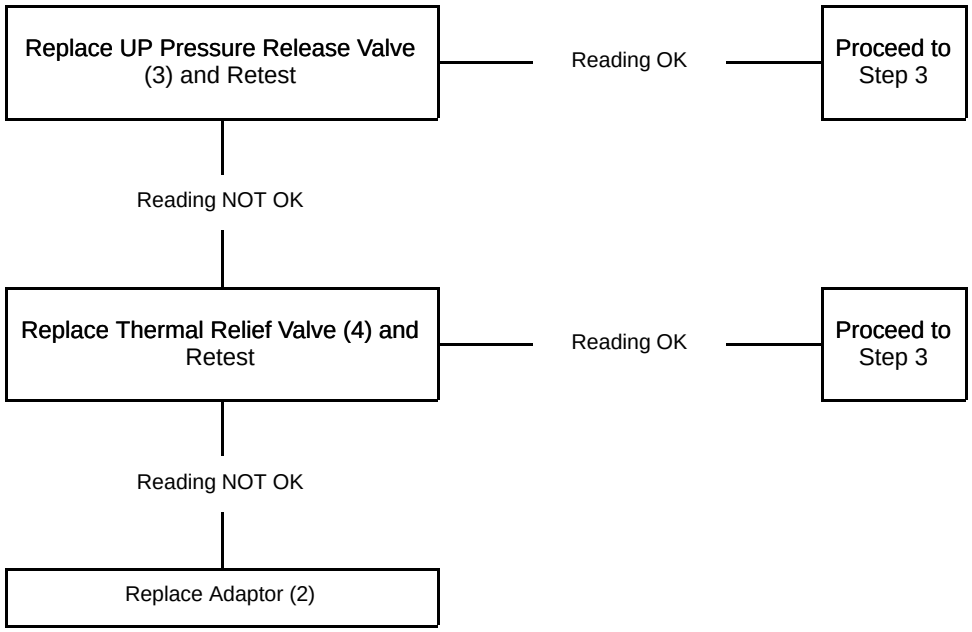
Internal Restriction Test

1. Open valves “A” and “B”.
2. Run pump OUT/UP and IN/DOWN while observing gauge.
3. Replace adapter if pressure is in excess of 200 psi (1379 kPa).

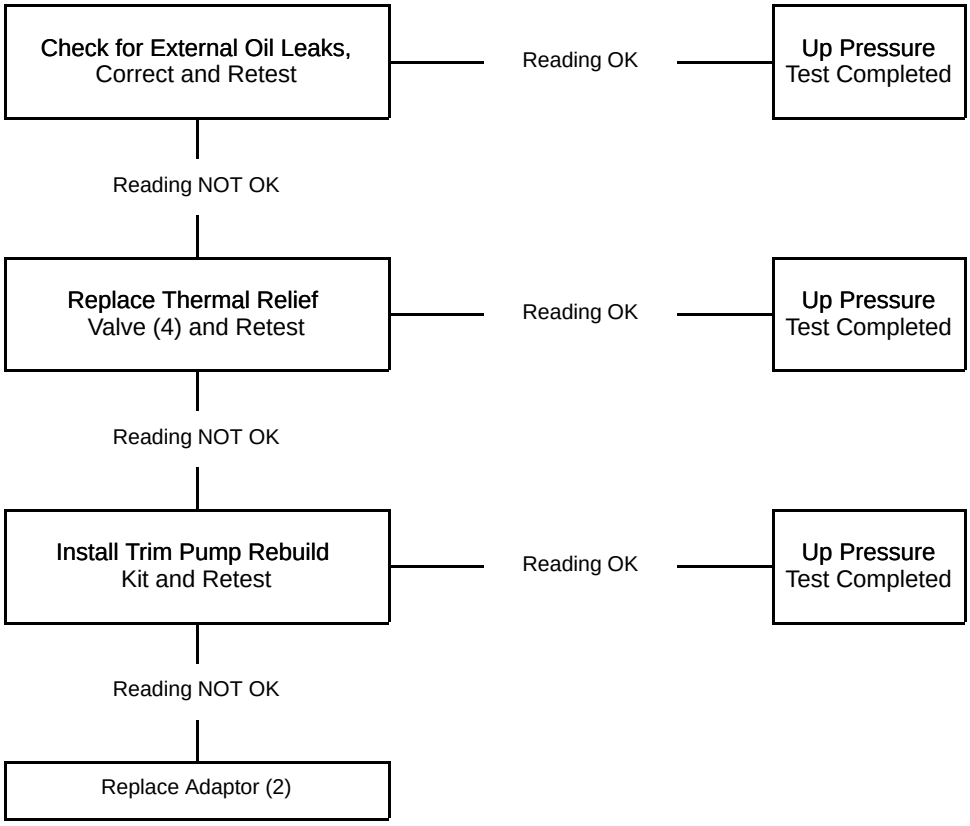
OUT/UP Pressure Test

NOTE: *The numbers in parenthesis, e.g. (3), refer to the trim pump hydraulic system diagram on page 5A-11.*

1. Leave valve “A” open and close valve “B.”
2. Run pump OUT/UP while observing the gauge. The reading should be 2200-2600 psi. (15173-17932 kPa).
   If Gauge reading is within specifications, proceed to step 3.
   If Gauge reading is not within specifications, perform the following:


Replace UP Pressure Release Valve (3) and Retest
Reading OK
Proceed to Step 3
Reading NOT OK
Replace Thermal Relief Valve (4) and Retest
Reading OK
Proceed to Step 3
Reading NOT OK
Replace Adaptor (2)

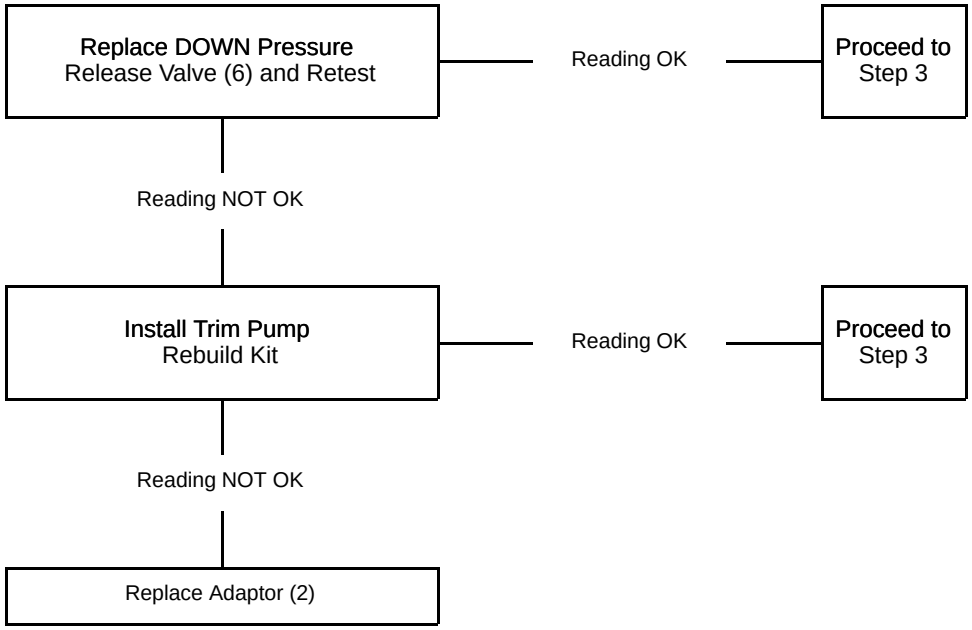
3. Run the pump OUT/UP until the gauge reading reaches 2200-2600 psi (15173-17932 kPa). Stop pumping OUT/UP The pressure should not fall below 1900 psi (13104 kPa). If Gauge reading is 1900 psi (13104 kPa) or above, UP pressure test completed. If Gauge reading is below 1900 psi (13104 kPa) perform the following:


Check for External Oil Leaks, Correct and Retest
Reading OK
Up Pressure Test Completed
Reading NOT OK
Replace Thermal Relief Valve (4) and Retest
Reading OK
Up Pressure Test Completed
Reading NOT OK
Install Trim Pump Rebuild Kit and Retest
Reading OK
Up Pressure Test Completed
Reading NOT OK
Replace Adaptor (2)

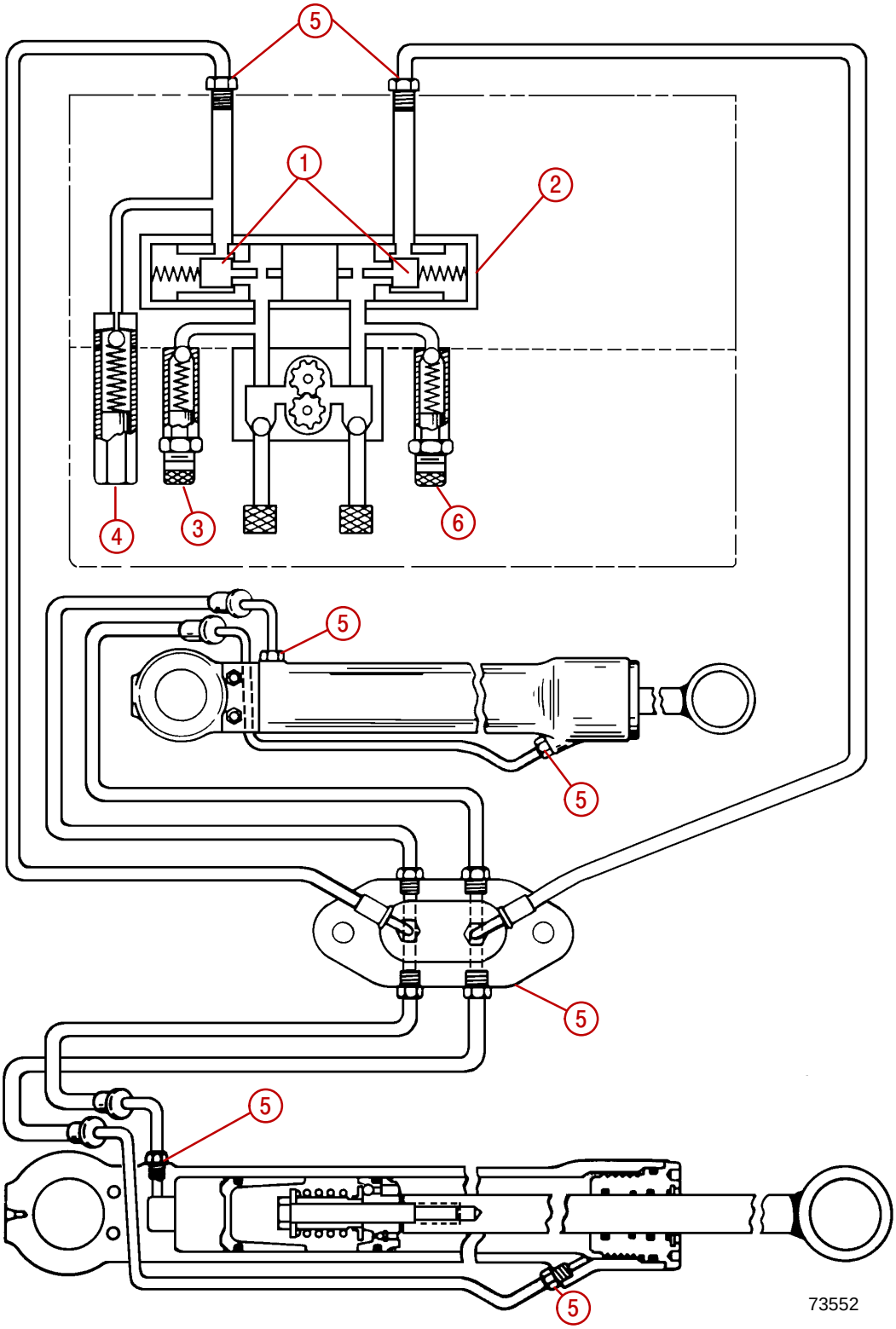
IN/DOWN Pressure Test

NOTE: *The numbers in parenthesis, e.g. (3), refer to the trim pump hydraulic system diagram.*

1. Close valve “A” and open valve “B.”
2. Run the pump IN/DOWN while observing the gauge. The reading should be 400-600 psi (2759-4138 kPa). If Gauge reading is within specifications, proceed to step 3. Gauge reading is NOT within specifications, perform the following.



Trim Pump Hydraulic System



1 - Shuttle
2 - Pump Adaptor
3 - OUTUP/ Pressure Relief Valve
4 - Thermal Relief Valve
5 - Fitting
6 - IN/DOWN Pressure Relief Valve

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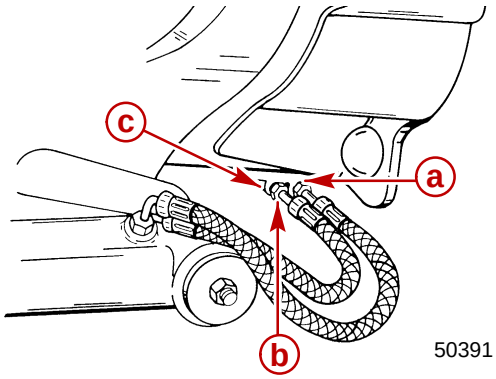
Trim Cylinder Internal Leak Test

IMPORTANT: Before performing the following test, ensure that OUT/UP pressure meets specifications designated in OUT/UP pressure test.

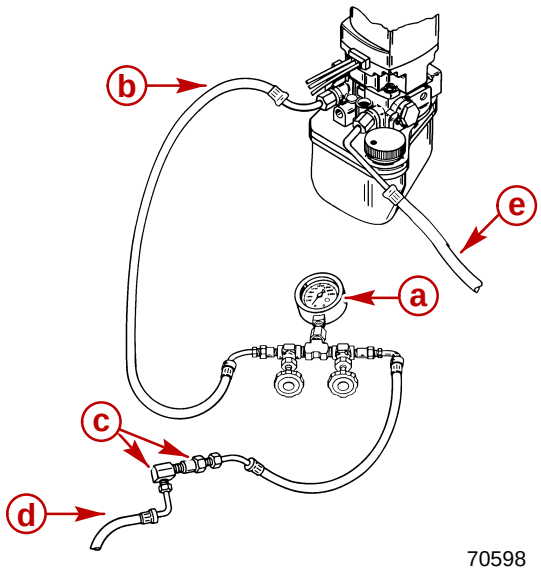
1. Reconnect the trim cylinder hoses (if removed in a previous test) as follows:
   a. Remove the plugs and caps.
   b. Install the UP hose to the forward hole on the hydraulic connector. Tighten securely.
   c. Install the DOWN hose to the aft hole on the hydraulic connector. Tighten securely.



50391

a - UP Hose
b - DOWN Hose
c - Hydraulic Connector

2. Connect the gauge at the most convenient location.

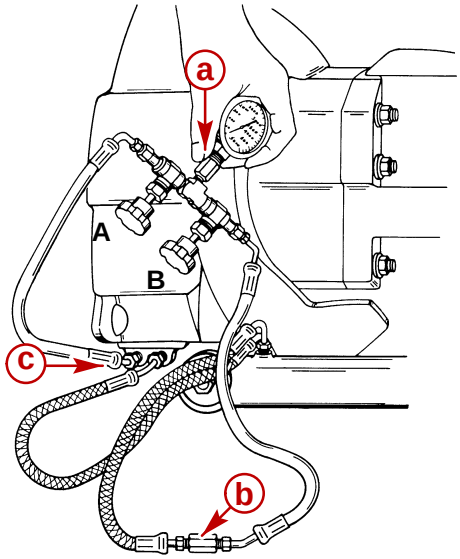


70598

Gauge Connected to Pump

a - Hydraulic Test Gauge
b - Hose Connected to UP (Left Hole)
c - Fittings - (Supplied with Gauge)
d - BLACK Hose (From Gimbal Housing)
e - GREY Hose (From Gimbal Housing)

Index



50390

Gauge Connected to Hydraulic Connector

a - Test Gauge
b - Coupling (Supplied with Gauge)
c - Front Hydraulic Connector Port

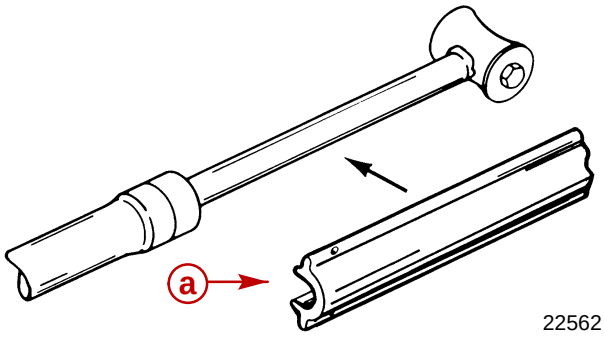
3. Open valves “A” and “B” and the run pump OUT/UP and IN/DOWN several times (to purge air).
4. Run the pump OUT/UP until the trim cylinders are fully extended; then, observe the gauge while pumping. The pressure should be 2200-2600 psi (15173-17932 kPa).
5. Stop pumping OUT/UP Pressure should not fall below 1900 psi (13104 kPa).
   a. **Reading below 1900 psi (13105 kPa)** indicates a trim cylinder leak. Use the following steps to locate the faulty cylinder.
   b. If the gauge is connected at the pump, reconnect the gauge at the gimbal housing hydraulic connector. Repeat step 2: then run the pump in the OUT/UP direction until the trim cylinder is fully extended.
   c. Close the valve on the test gauge an repeat Steps 3 and 4.

- **If Reading is now within specification:** The trim cylinder on the same side that test gauge is connected to is faulty.
- **If Reading is still not within specification:** The trim cylinder on the opposite side from where the test gauge is connected is faulty.

Trim Cylinder Shock Piston Test

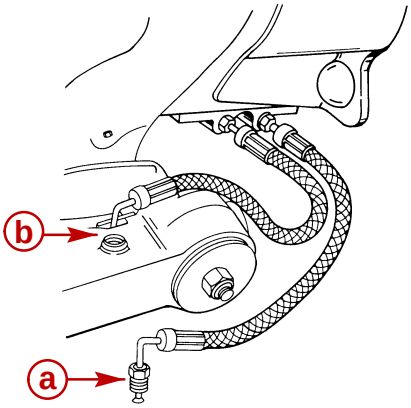
If all previous trim system test results meet specifications, but drive unit will not trim "In"/"Down," the problem may be a leaky trim cylinder shock piston. Use the following test to check for this condition. No test gauge required.

1. Run the pump in the OUT/UP direction until the trim cylinders are fully extended.
2. Use a suitable devise to keep trim cylinder piston rods from retracting. The Quicksilver Trailering Kit works well for this purpose.



a - Trailering Clip

3. Disconnect the UP trim hose from trim cylinders.



a - UP Trim Hose
b - Front Connection

4. Run the pump in the IN/DOWN direction. If oil flows from the UP port on the trim cylinder, the shock piston is leaking and must be replaced.

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Motor and Electrical Bench Tests

Trim Pump Motor Test (In Boat)

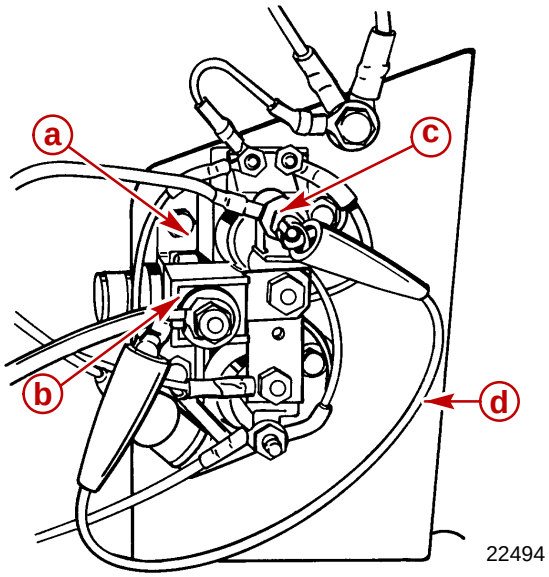
⚠ WARNING

Making electrical connections may cause a spark. DO NOT perform this test near flammables (or explosives).

⚠ WARNING

Remain clear of the drive unit when performing power trim pump motor tests with pump in the boat and hydraulic hoses connected.

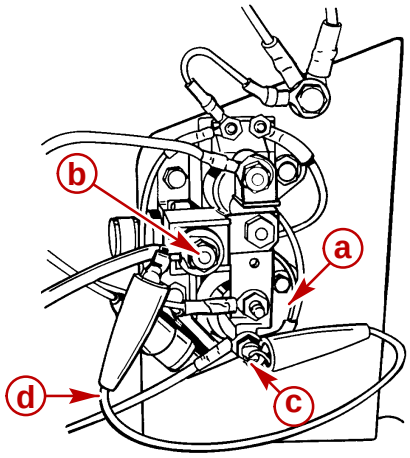
1. OUT/UP Operation.
   a. Connect a jumper wire between the positive (+) solenoid terminal and the blue-white motor lead terminal.
   b. The motor should run.



IN/DOWN Position

a - OUT/UP Solenoid
b - Positive Terminal (+)
c - BLUE-WHITE Motor Lead Terminal
d - Jumper Wire

2. IN/DOWN Operation.
   a. Connect a jumper wire between the positive (+) solenoid terminal and the green-white motor lead terminal.
   b. The motor should run.



73556

a - IN/DOWN Solenoid
b - Positive Terminal (+)
c - GREEN-WHITE Motor Lead Terminal
d - Jumper Wire

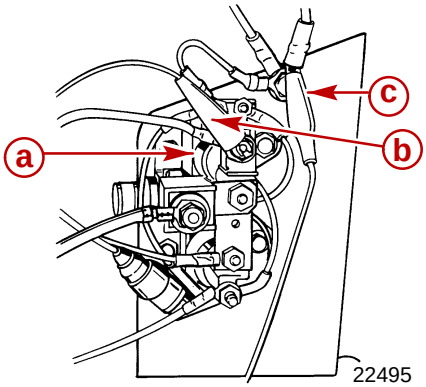
3. If the motor does not run, refer to “Motor Repair.”

Trim Pump Motor Test (Out of Boat)

⚠ WARNING

Making electrical connections may cause a spark. DO NOT perform this test near flammables or explosives.

1. Remove the trim pump from the boat. Refer to “Trim Pump Removal”.
2. Remove the fluid from the trim pump reservoir.
3. OUT/UP Operation
   a. Connect a 12 volt Positive (+) supply lead to the blue-white motor lead terminal.
   b. Connect the negative (–) supply lead to a good ground on the pump.
   c. The motor should run.



22495

a - OUT/UP Solenoid
b - 12 Volt Positive (+) Supply Lead
c - Negative Supply Lead

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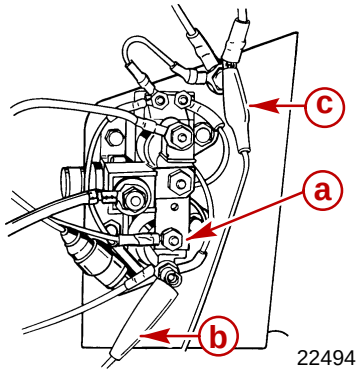
4. IN/DOWN Position.
   a. Connect a 12 volt Positive (+) supply lead to the green-white motor lead terminal.
   b. Connect the negative (–) supply lead to a good ground on the pump.
   c. The motor should run.



a - IN/DOWN Solenoid
b - 12 Volt Positive Supply (+) Lead
c - GREEN-WHITE Motor Lead
d - Jumper Wire

5. If the motor does not run, refer to “Motor Repair.”

Solenoid Test (Pump In Boat)

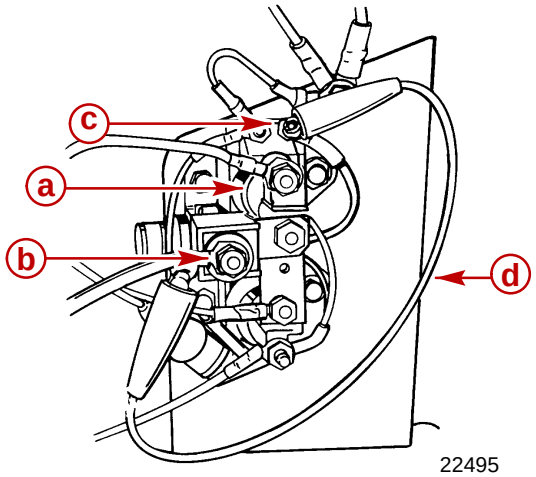
⚠ WARNING

DO NOT perform this test near flammables (or explosives) as a spark may occur when making connections.

⚠ CAUTION

Remain clear of the drive unit when performing power trim pump motor tests with pump in the boat and hydraulic hoses connected.

1. UP/OUT Solenoid.
   a. Connect a jumper wire between the positive (+) solenoid terminal and the blue-white harness wire terminal.
   b. The motor should run.



a - OUT/UP Solenoid
b - Positive (+) Solenoid Terminal
c - BLUE-WHITE Harness Wire Terminal
d - Jumper Wire

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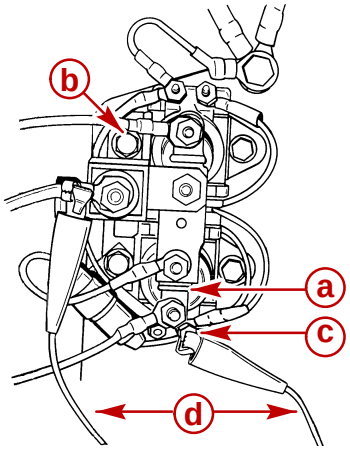
2. IN/DOWN Solenoid.
   a. Connect a jumper between the positive (+) solenoid terminal and the green-white harness wire terminal.
   b. The motor should run.



22494

a - IN/DOWN Solenoid
b - Positive (+) Solenoid Terminal
c - GREEN-WHITE Harness Wire Terminal
d - Jumper Wire

3. If the pump motor does not run in one direction or another, replace the appropriate solenoid.

See the wiring diagram on page 5A-51.

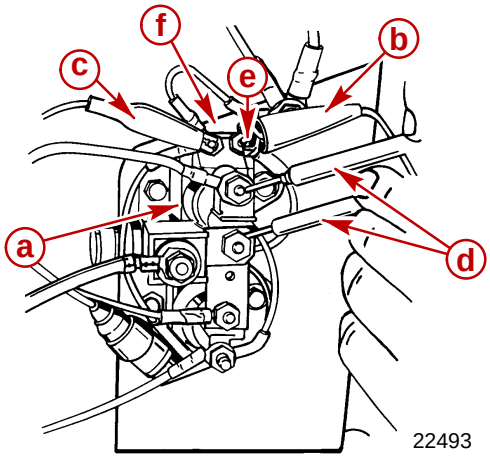
Solenoid Test (Pump Out of Boat)

⚠ WARNING

DO NOT perform this test near flammables (or explosives) as a spark may occur when making connections.

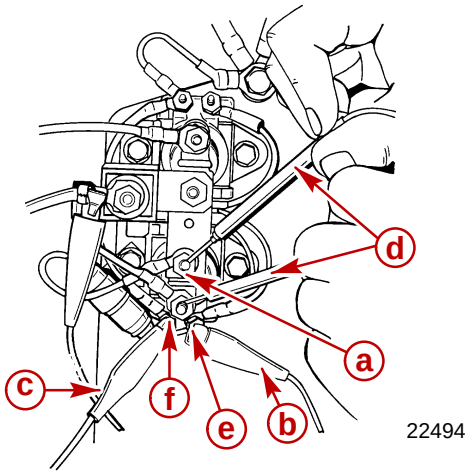
1. Remove the trim pump from the boat. Refer to “Trim Pump Removal”.
2. Remove the fluid from the trim pump reservoir.
3. OUT/UP Solenoid.
   a. Connect a 12 volt Positive (+) supply lead to blue-white harness terminal wire.
   b. Connect the negative (–) supply lead to the solenoid ground terminal as shown.

c. Connect the ohmmeter leads to the large terminals on the solenoid.



a - OUT/UP Solenoid
b - 12 volt Positive (+) Supply Lead
c - Negative (–) Supply Lead
d - Ohmmeter Leads
e - BLUE-WHITE Harness Wire Terminal
f - Solenoid Ground Terminal

4. **Zero Ohms Reading** (Full Continuity)-Solenoid is OK.
   High Ohms Reading (No Continuity)-Replace solenoid.
5. IN/DOWN Solenoid.
   a. Connect a 12 volt positive (+) supply lead to the green-white harness wire terminal.
   b. Connect the negative (–) supply lead to the solenoid ground terminal.
   c. Connect the ohmmeter leads to the large terminals on the solenoid.



a - IN/DOWN Solenoid
b - 12 Volt Positive (+) Supply Lead
c - Negative (–) Supply Lead
d - Ohmmeter Leads
e - GREEN-WHITE Harness Wire Terminal
f - Solenoid Ground Terminal

6. **Zero Ohms Reading** (Full Continuity)-Solenoid is OK.
   High Ohms Reading (No Continuity)-Replace solenoid.

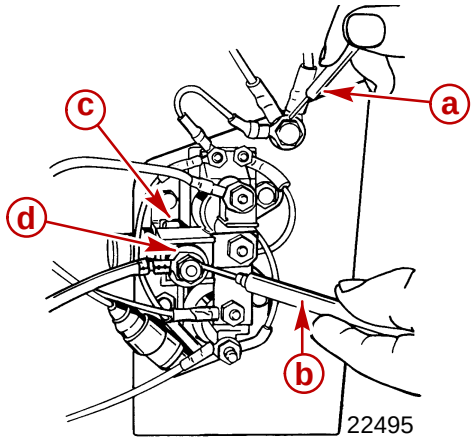
See the wiring diagram on page 5A-51.

110 Amp Fuse Test (Pump in Boat)

⚠ WARNING

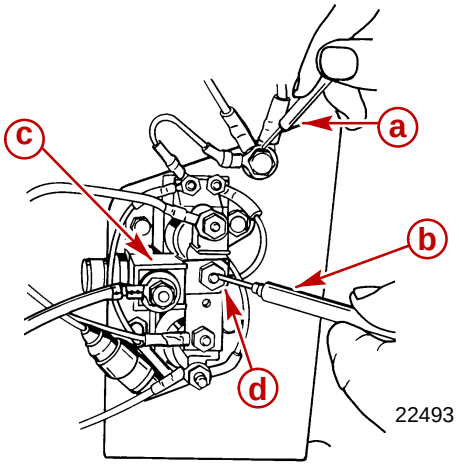
DO NOT perform this test near flammables (or explosives) as a spark may occur when making connections.

1. Check for voltage at terminal “d” using a volt meter. Voltage MUST BE indicated before proceeding with the next check.



a - Volt Meter Negative (-) Lead
b - Volt Meter Positive (+) Lead
c - Fuse (RED in Color)
d - Check for Voltage Here

2. Check for voltage at terminal “d” using a volt meter.
   a. **Voltage Indicated:** Fuse O.K.
   b. **Voltage Not Indicated:** Replace the fuse.



a - Volt Meter Negative (-) Lead
b - Volt Meter Positive (+) Lead
c - Fuse (RED in Color)
d - Check for Voltage Here

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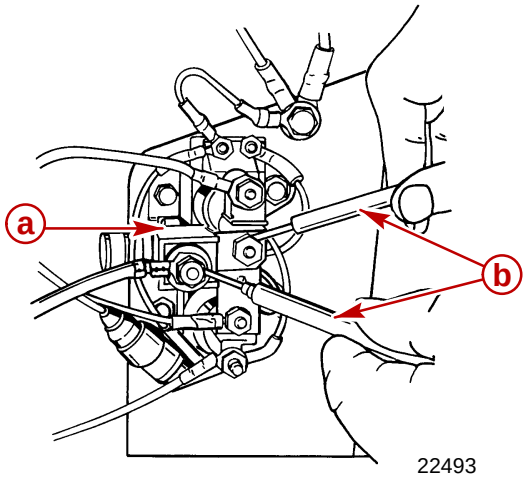
110 Amp Fuse Test (Pump Out of Boat)

1. Connect the ohmmeter leads between the terminals on the fuse.

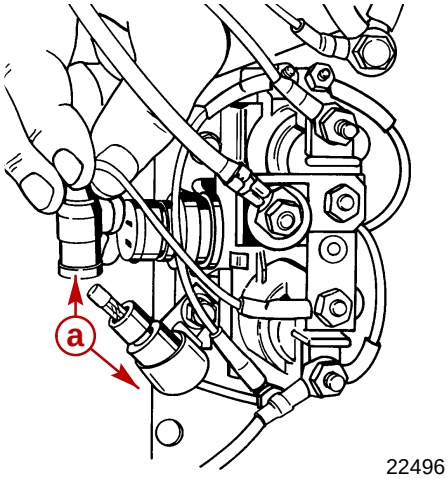


a - 110 Amp Fuse (Red)
b - Ohmmeter Leads

Zero Ohms Reading (Full Continuity)-Fuse OK.
High Ohms Reading (No Continuity)-Replace fuse.

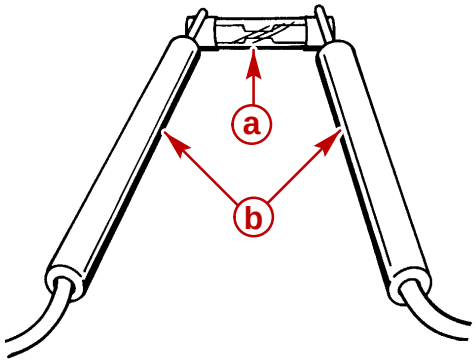
20 Amp Fuse Test

1. Remove the fuse from the fuse holder.



a - Fuse Holder

2. Connect one ohmmeter lead to each end of the fuse.

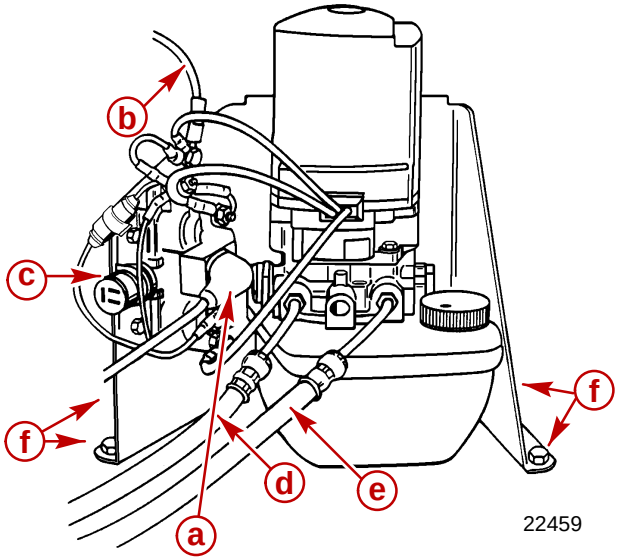


a - 20 Amp Fuse
b - Ohmmeter Leads

Zero Ohms Reading (Full Continuity)-Fuse OK.
High Ohms Reading (No Continuity)-Replace fuse.

Trim Pump Removal

1. Disconnect the trim pump battery leads from the battery. Disconnect the negative lead first.
2. Disconnect the trim harness connector (3 pronged connector) from the trim pump.
3. Remove the hydraulic hoses from the trim pump. Cap the hose ends.
4. Remove the lag bolts and washers. Then, lift the pump and floor bracket from the boat.



a - Positive Battery Lead
b - Negative Battery Lead
c - Harness Connector
d - BLACK Hydraulic Hose (UP Hose)
e - GRAY Hydraulic Hose (DOWN Hose)
f - Lag Bolts and Washers

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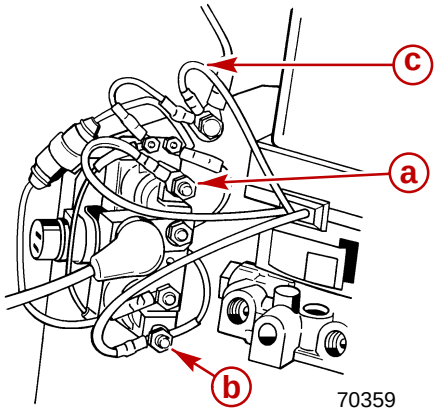
Hydraulic Repair

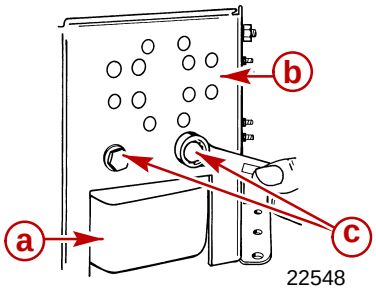
Disassembly

1. Disconnect the trim motor wires.



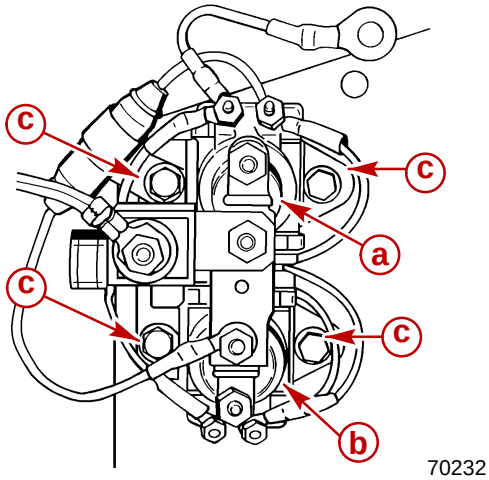
a - BLUE/WHITE Motor Wire
b - GREEN/WHITE Motor Wire
c - BLACK Ground Wire

2. Remove the mounting bolts and trim pump from the floor bracket.



a - Trim Pump
b - Floor Bracket
c - Mounting Bolts

3. Remove the solenoids if replacement is necessary.



a - UP Solenoid
b - DOWN Solenoid
c - Mounting Bolts (2 on Each Solenoid)

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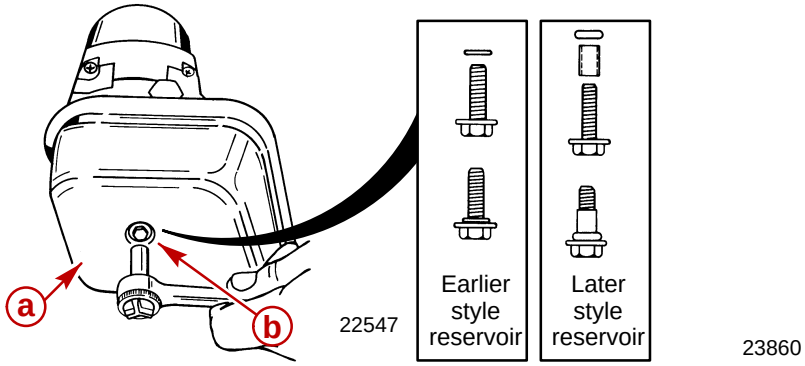
4. Remove the pump reservoir.

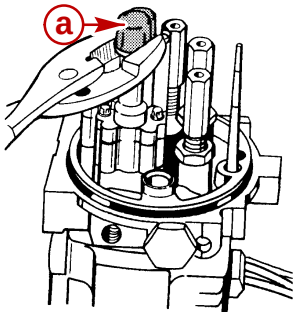


22547 23860

a - Pump Reservoir
b - Bolt and O-ring - Spacer

Filter Replacement

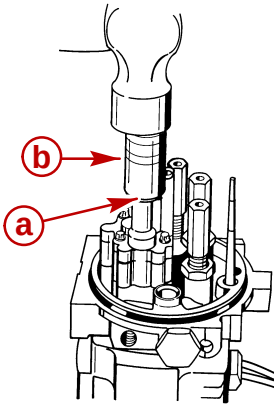
1. Remove the filter by twisting while pulling upward.



70932

a - Filter

2. Install a new filter.



22547

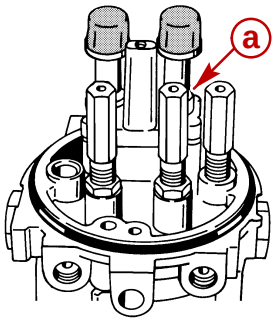
a - Filter
b - 5/8 in. Socket

UP Pressure Relief Valve Replacement

NOTE: *The UP pressure relief valve in the kit is color coded blue for easy identification.*

IMPORTANT: A difference exists between the factory installed and the replacement pressure relief valves. Once the jam nut is loosened on a factory installed relief valve, the valve is out of adjustment.

IMPORTANT: When installing a replacement pressure relief valve, DO NOT loosen or attempt to remove the hex "jam" nut. This valve is preset at the factory for proper UP pressure relief.

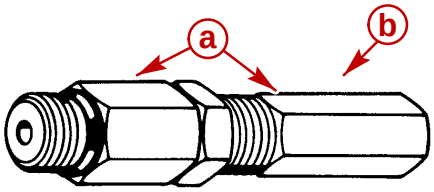


70872

a - Factory Installed UP Pressure Relief Valve

NOTE: *Original factory installed pressure relief valves will be a natural steel finish - they will NOT be color coded.*

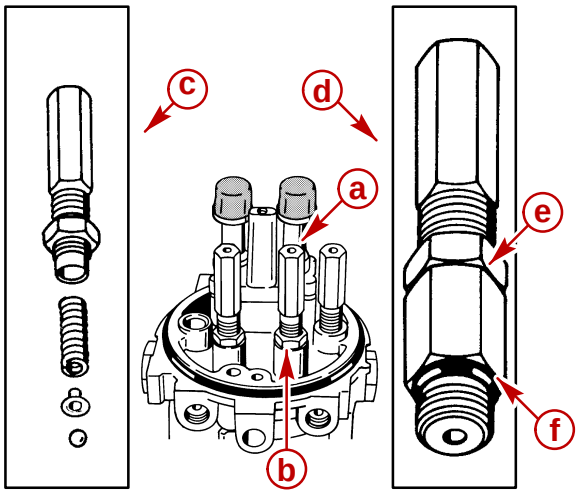
1. Replace the UP pressure relief valve. Ensure that the threaded hole is free of dirt. Lubricate the O-ring at the base of the new valve with Power Trim and Steering Fluid and install. Torque to 70 lb. in. (7.9 N·m).



50396

Current Replacement Pressure Relief Valve

a - Replacement UP Pressure Relief Valve
b - Color Coded Blue Area



50396 70872 50396

Original Factory Installed Pressure Relief Valve

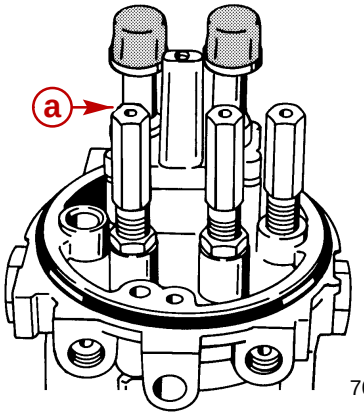
a - Original Factory Installed UP Pressure Relief Valve
b - Jam Nut - Loosen Before Removing the Valve
c - Be Sure to Remove the Pump Body Components (Spring, eyelet, Check Ball) - Discard
d - Replacement UP Pressure Relief Valve (Blue) - Use the Base of the valve for tightening
e - Jam Nut - DO NOT TURN or Attempt to Loosen
f - O-ring

DOWN Pressure Relief Valve Replacement

NOTE: *The DOWN pressure relief valve in the kit is color coded green for easy identification.*

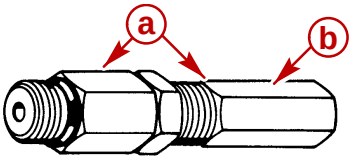
IMPORTANT: A difference exists between the factory installed and the replacement pressure relief valves. Once the jam nut is loosened on a factory installed relief valve, the valve is out of adjustment.

IMPORTANT: When installing a replacement pressure relief valve, DO NOT loosen or attempt to remove the hex “jam” nut. This valve is preset at the factory for proper DOWN pressure relief.



70872

a - Factory Installed DOWN Pressure Relief Valve



50396

a - Replacement DOWN Pressure Relief Valve
b - Color Coded Green Area

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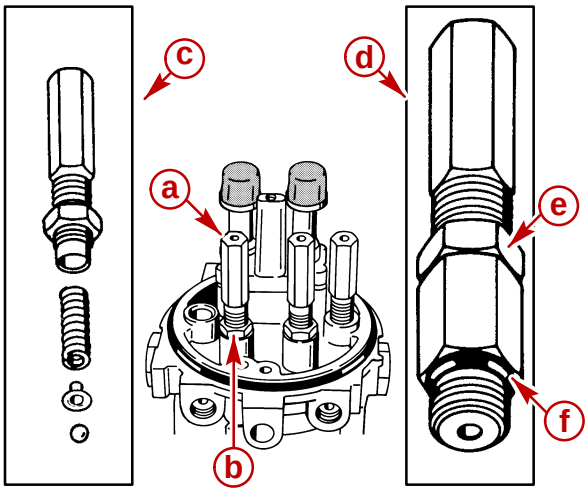
1. Replace the DOWN pressure relief valve. Remove the pump body components and discard. Ensure that the threaded hole is free of dirt. Lubricate the O-ring at the base of the new valve with Power Trim and Steering Fluid and install. Torque to 70 lb. in. (7.9 N·m). Use the base of the valve for tightening; DO NOT TURN or attempt to loosen the jam nut.



50396 70872 50396

Original Factory Installed Pressure Relief Valve

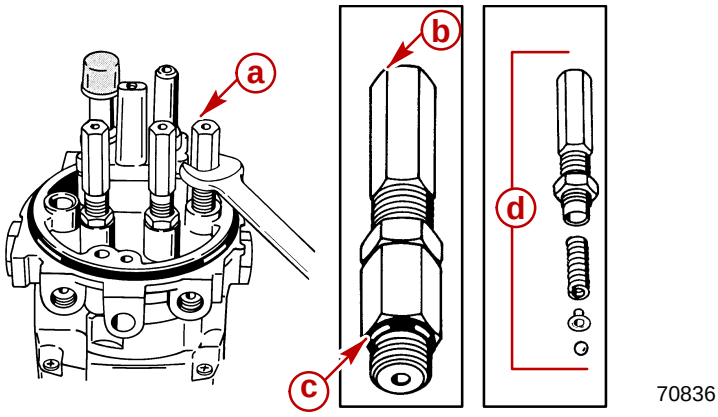
a - Original Factory Installed DOWN Pressure Relief Valve
b - Jam Nut - Loosen Before Removing the Valve
c - Pump Body Components (Spring, Eyelet, Check Ball)
d - Replacement DOWN Pressure Relief Valve (GREEN)
e - Jam Nut
f - O-ring

Thermal Relief Valve Replacement

NOTE: *The Thermal Relief Valve in the kit is color coded gold for easy identification.*

IMPORTANT: The thermal relief valve is factory preset. DO NOT loosen or attempt to separate the component parts. Do not use a wrench on the upper gold colored fitting. Use a wrench on the lower hex-fitting to tighten the relief valve.

1. Replace the thermal relief valve. Remove the pump body components and discard. Ensure that the threaded hole is free of dirt. Lubricate the O-ring at the base of the new valve with Power Trim and Steering Fluid and install. Torque to 70 lb. in. (7.9 N·m). Use the base of the valve for tightening; DO NOT TURN or attempt to loosen the jam nut.



70836

a - Thermal Relief Valve
b - Replacement Thermal Relief Valve (Gold)
c - O-ring
d - Pump Body Components (Spring, Eyelet, Check Ball)

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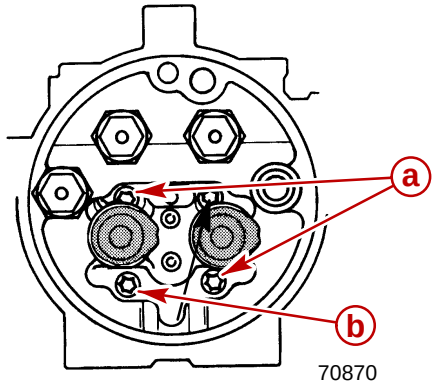
Pump Replacement

NOTE: *The pump is cannot be re-built. If the pump is defective, replace it as an assembly.*

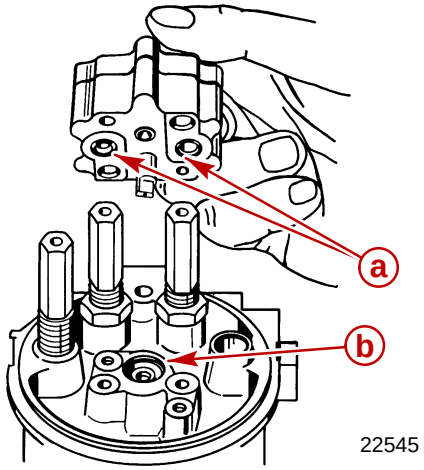
1. Remove the pump attaching screws with a hex lobular socket or standard 3/16 in. (188mm) socket and the pump. Do NOT loosen the pump assembly screws.



70870

a - Screw
b - Pump Assembly Screws

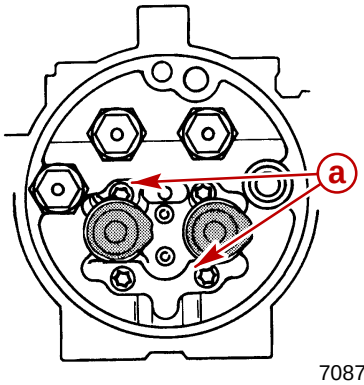
2. Remove the O-rings from the old pump and install them on the new pump.
3. Lubricate the lip of the adapter seal with light weight oil.



22545

a - O-rings
b - Adapter Seal

4. Install the pump and torque the pump screws to 70 lb. in. (7.9 N·m) using a hex lobular socket or standard 3/16 in. (188mm) socket.



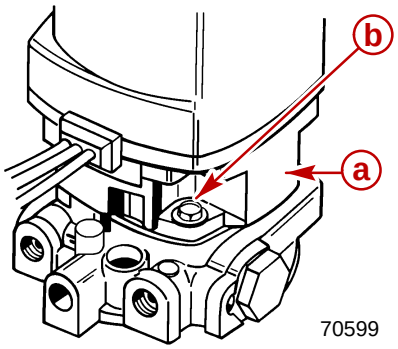
70870

a - Screws

Index

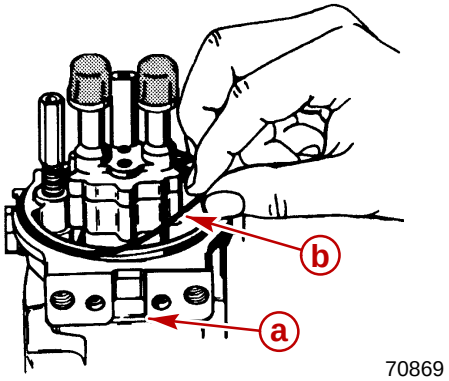
Adapter Replacement

1. Remove the pump motor attaching screws and remove the pump motor.



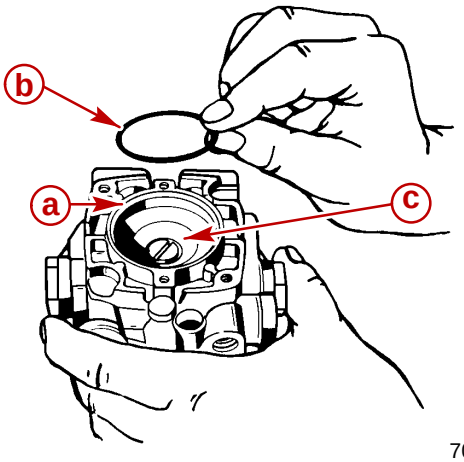
a - Pump Motor
b - Screws (2)

2. Remove and discard the adapter to reservoir O-ring.



a - Adapter
b - O-ring

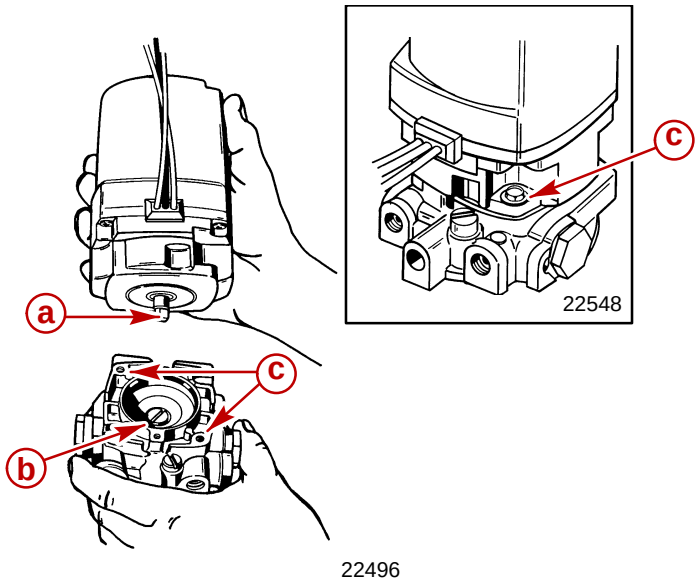
3. Remove and discard the motor to adapter O-ring.
4. If present, remove the vent screw (dipstick) from the old adapter.
5. If present, install the vent screw (dipstick) and new O-ring into the new adaptor.
6. Ensure that the coupling is installed so that the shallow slot is toward the reservoir. Lubricate the coupling with 2-4-C Marine Lubricant with Teflon.



a - Adapter
b - O-ring
c - Coupling - (Shallow Slot Toward Reservoir)

Index

7. Align the motor shaft with the coupling and install the motor onto the adapter. Position the motor as shown and secure with screws. Tighten securely.

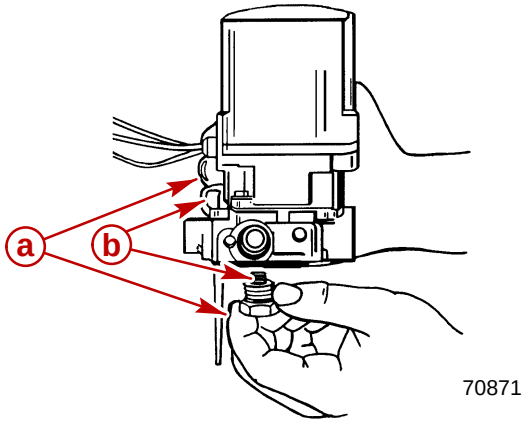


a - Motor Shaft
b - Coupling
c - Screws (Opposite Corners)

Adapter Repair

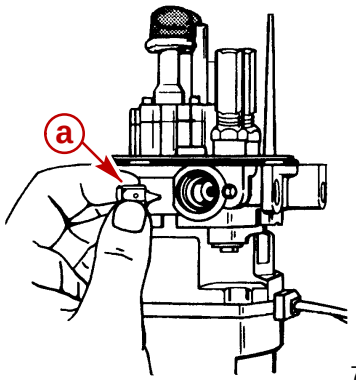
INTERNAL O-RING and POPPET VALVE REPLACEMENT

1. Remove the hex plug retainers and springs (one on each side).



a - Hex Plug Retainers (2)
b - Springs (2)

2. Remove and discard the poppet valves.

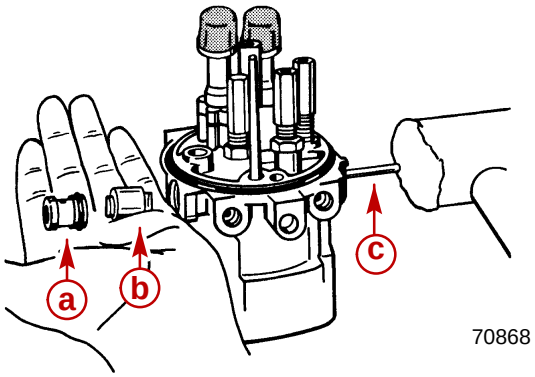


a - Poppet Valve

⚠ CAUTION

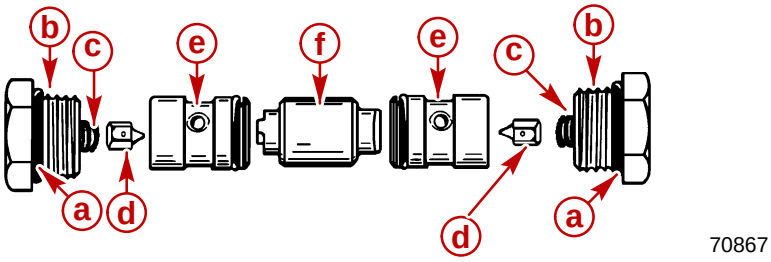
Use care in removing check valve bodies from adapter, so as not to damage poppet valve seat surface on valve body.

3. Remove the check valve bodies and spool.



a - Check Valve Body
b - Spool
c - Metal Rod

4. Remove and discard the O-rings on the hex plug retainers.
5. Discard the check valve bodies.
6. Clean the hex plug retainers and spool.



a - O-rings
b - Hex Plug Retainers
c - Springs
d - Poppet Valves
e - Check Valve Bodies
f - Spool

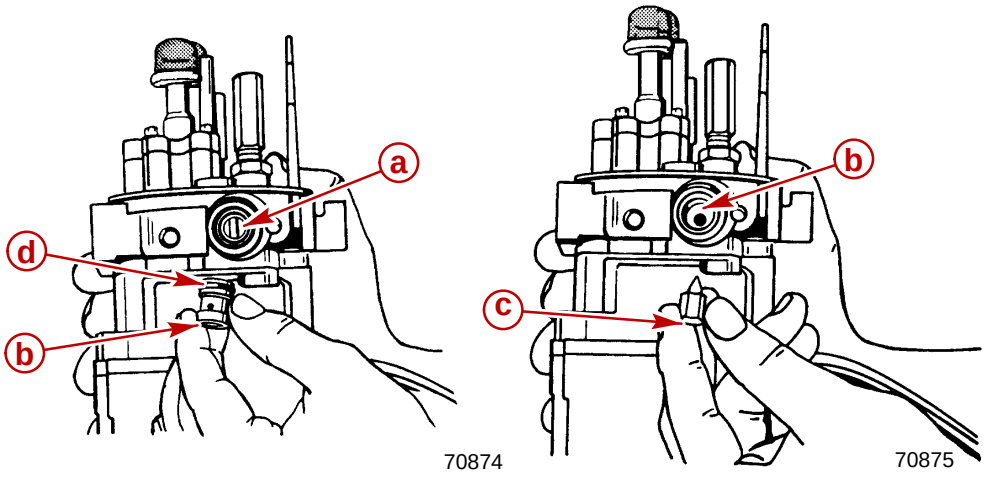
Index

7. Lubricate the check valve body O-rings with Power Trim and Steering Fluid, or with 10W-30 or 10W-40 motor oil.

⚠ CAUTION

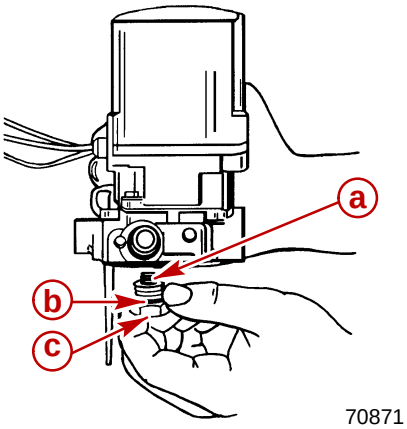
DO NOT force check valve bodies into adapter as damage to O-rings may result.

8. Place the spool and check valve bodies into the adapter.
9. Place the poppet valves into the check valve bodies.



a - Spool
b - Check Valve Body (2)
c - Poppet Valve (2)
d - Check Valve Body O-ring

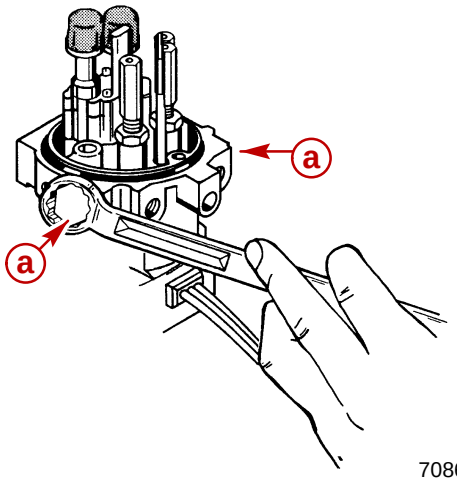
10. Lubricate the hex plug retainer O-rings with Quicksilver Power Trim and Steering Fluid, or 10W-30 or 10W-40 motor oil.
11. Place the springs into the hex plug retainers.
12. Thread the hex plug retainers into the adapter by hand until the retainer contacts the check valve body.



a - Spring (2)
b - O-ring
c - Hex Plug Retainer (2)

Hex plug retainers MUST BE turned into adapter exactly as outlined or damage to check valve body O-rings may result.

13. Tighten the hex plug retainer securely on each side.

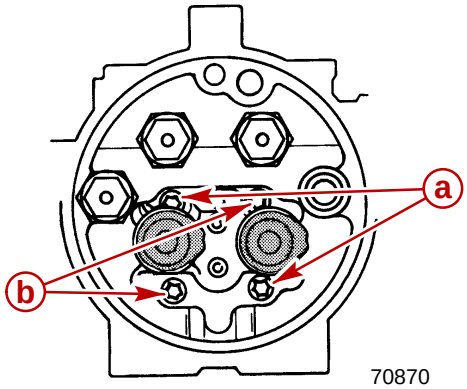


70866

a - Hex Plug Retainer

Pump Shaft Oil Seal Replacement

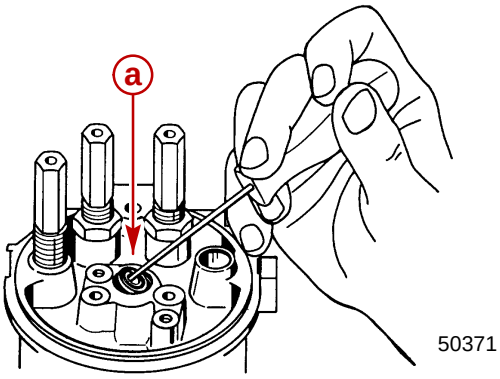
1. Remove the pump attaching screws with a hex lobular socket or standard $^{3}/_{16}$ in. (188mm) socket. Remove pump. DO NOT loosen or remove the pump assembly screws.



70870

a - Screw
b - Pump Assembly Screw

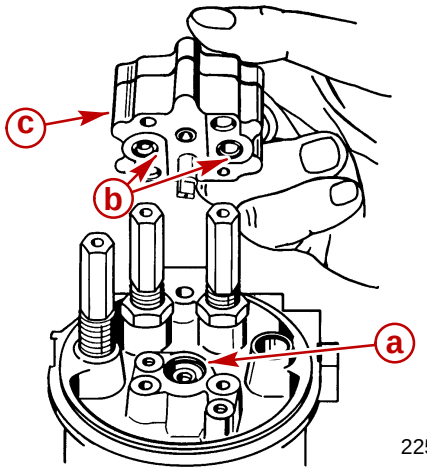
2. Remove the oil seal by prying out with a screwdriver.



50371

a - Oil Seal

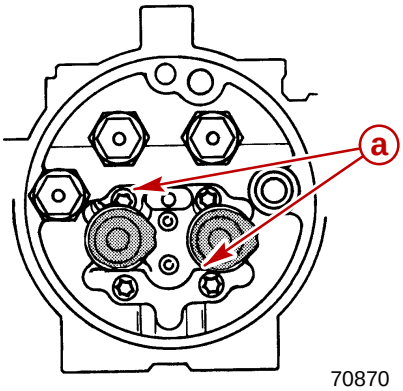
3. Remove and replace the O-rings on the pump base if they are worn.
4. Install a new seal with the lips toward the pump. The oil seal can be pressed in by hand.
5. Lubricate the lip of the seal with light weight oil.



22545

a - Oil Seal
b - O-rings
c - Pump

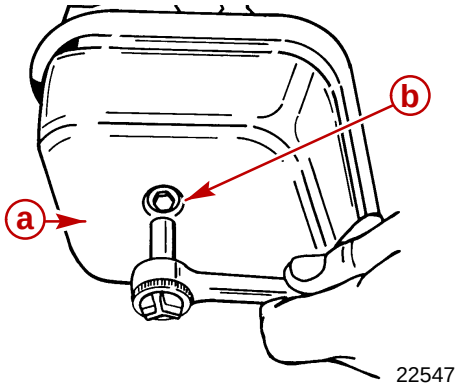
6. Install the pump and torque the attaching screws to 75 lb. in. (8 N·m) using a hex lobular socket or standard 3/16 in. (188mm) socket.



70870

a - Screws

7. Install the pump reservoir.



22547

a - Pump Reservoir
b - Bolt and O-ring - Spacer

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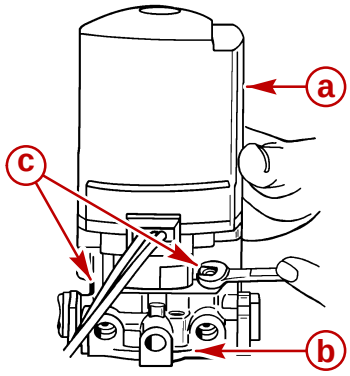
Motor Repair

Disassembly

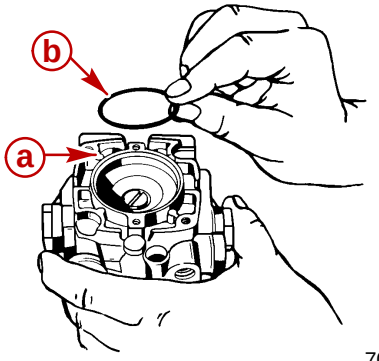
1. Remove the trim motor from the adapter.



70363

a - Trim Motor
b - Adapter
c - Screws

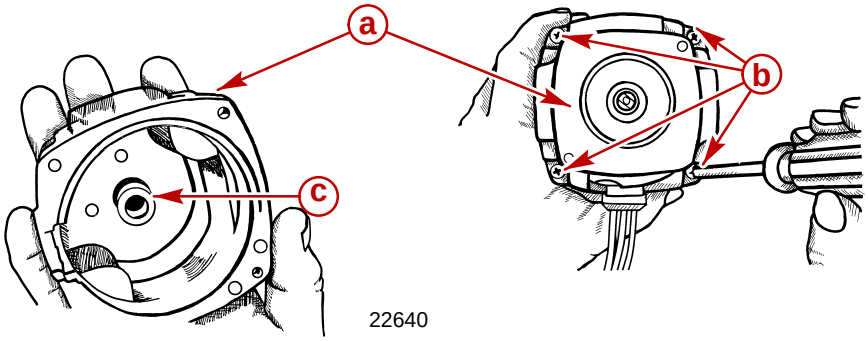
2. Remove the motor to adapter O-ring.



70600

a - Adapter
b - O-ring

3. Remove the motor end cover and washer from the armature shaft bushing.



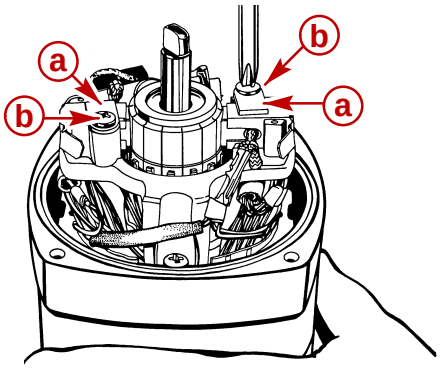
22640

22639

a - Cover
b - Screws (4)
c - Washer

Index

4. Loosen the brush hold down arms.

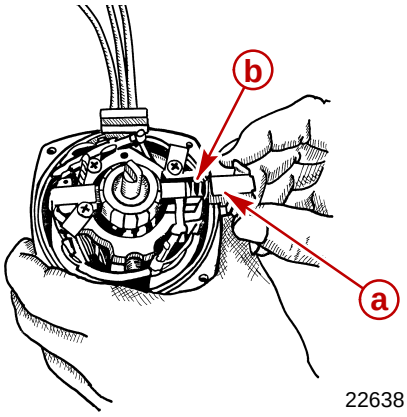


22648

a - Brush Hold Down Arms
b - Screws

IMPORTANT: Use care in removing brush holders so as not to lose springs.

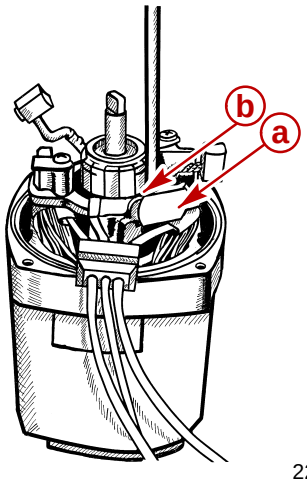
5. Remove the brush holders and springs.



22638

a - Brush Holder
b - Spring

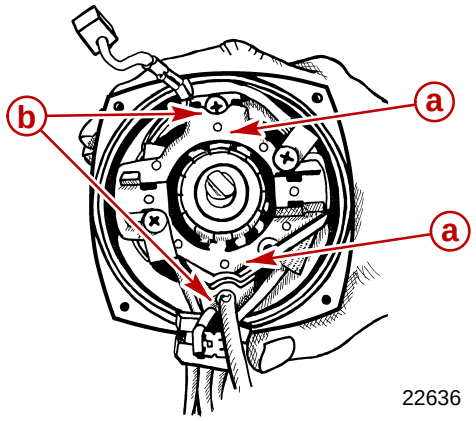
6. Remove the thermal switch and brush assembly.



22637

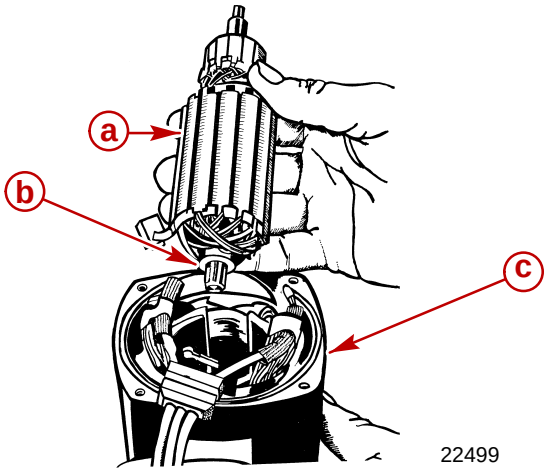
a - Thermal Switch and Brush
b - Screw

7. Remove the brush assembly mounting bracket.



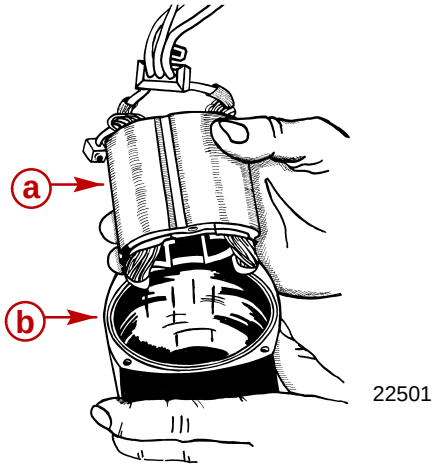
a - Brush Assembly Bracket
b - Screws

8. Remove the armature and thrust washer from the motor housing.



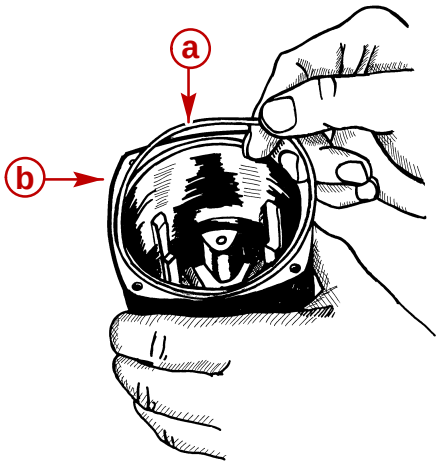
a - Armature
b - Thrust Washer
c - Motor Housing

9. Remove the field assembly from the motor housing.



a - Field Assembly
b - Motor Housing

10. Remove the motor housing O-ring.



22645

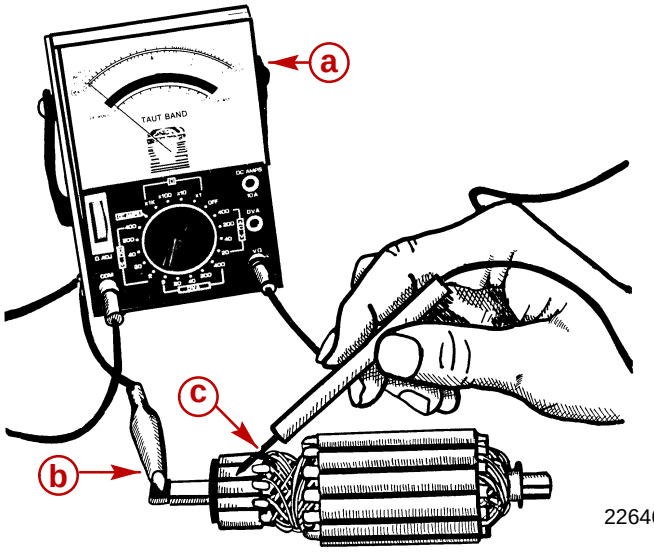
a - O-ring
b - Motor Housing

Armature Tests

Continuity Test

1. Set the ohmmeter on the Rx1 scale.
2. Place the alligator clip meter lead on the armature shaft.
3. Touch the meter lead probe to each commutator bar one at a time.

Continuity Indicated - Armature grounded (replace armature).
Continuity Not Indicated - Armature not grounded.



22646

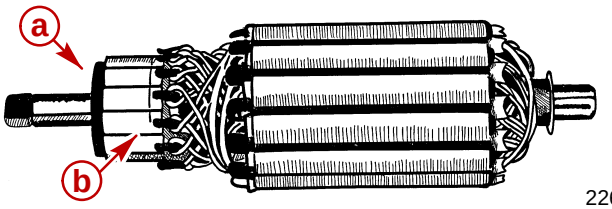
a - Ohmmeter – Set on Rx1 Scale
b - Meter Lead – Place on Armature
c - Meter Lead – Place on All Commutator Bars (One at a time)

Test for Shorts

1. Check the armature on a growler (follow the growler manufacturers instructions). Replace the armature if it has a short.

Cleaning Commutator

1. Clean the commutator with “00” garnet grit sandpaper. DO NOT use emery paper.
2. Check the gaps between the commutator bars for material. Remove material if present.



22647

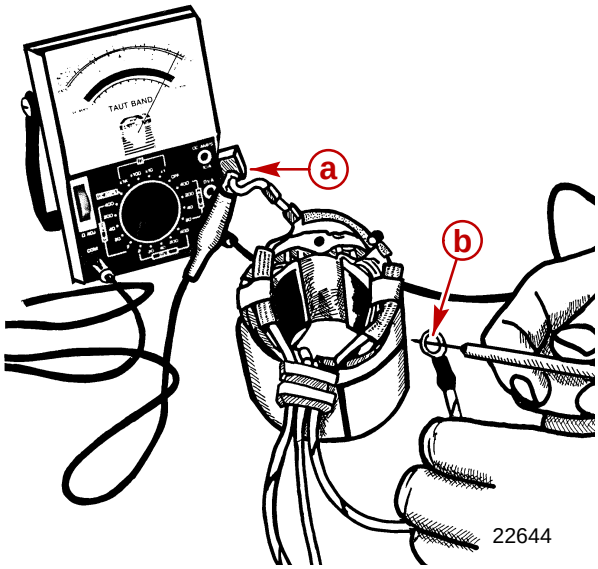
a - Commutator
b - Gap

Field Tests

Test for Open Circuit

1. Connect the ohmmeter between the field brush lead and the blue-white lead.

Zero ohms indicated (full continuity) - Field OK.
Zero ohms not indicated (no continuity) - Replace field assembly.

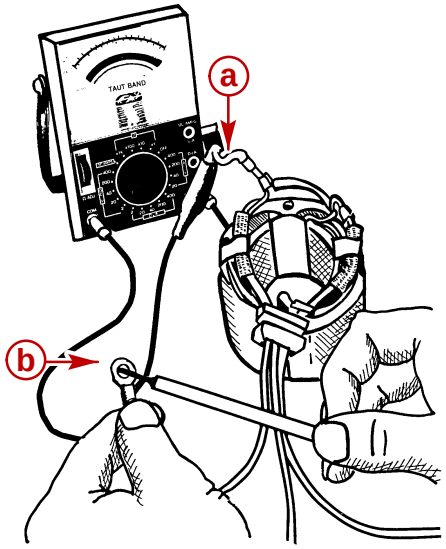


22644

a - Ohmmeter Lead - Connected to Brush Lead
b - Ohmmeter Lead - Connected to Blue/White Lead

2. Connect the ohmmeter between the field brush lead and the green-white lead.

Zero ohms indicated (full continuity) - Field OK.
Zero ohms not indicated (no continuity) - Replace field assembly.

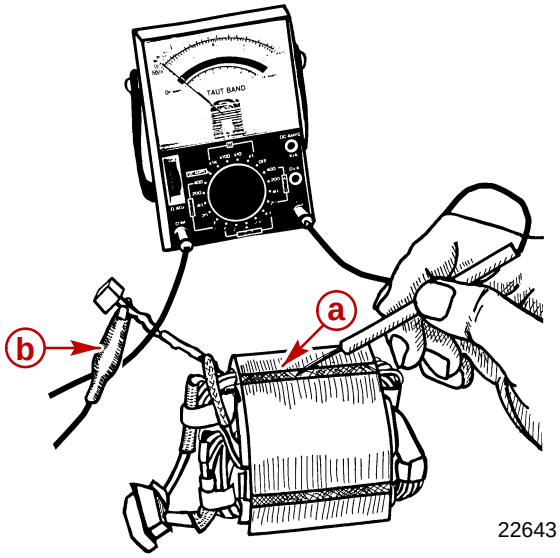


a - Ohmmeter Lead - Connected to Brush Lead
b - Ohmmeter Lead - Connected to Green/White Lead

Test for Short in Field

1. Connect the ohmmeter between the field brush lead and the field frame.

Zero ohms indicated (full continuity) - Short indicated (replace field assembly).
Zero ohms not indicated (no continuity) - Field OK.

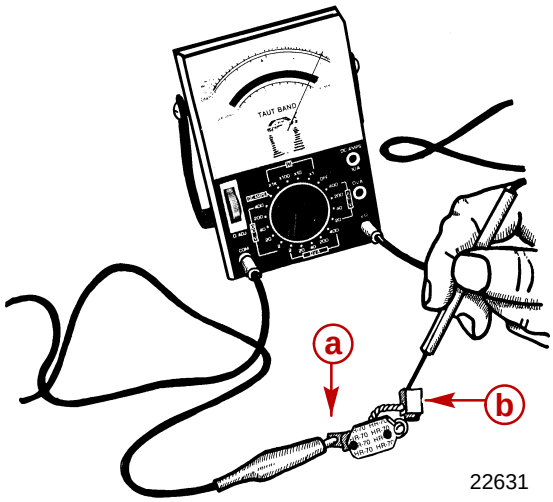


a - Field Frame
b - Field Brush Lead

Thermal Switch Continuity Test

1. Connect the ohmmeter between the spade connector and the brush lead.

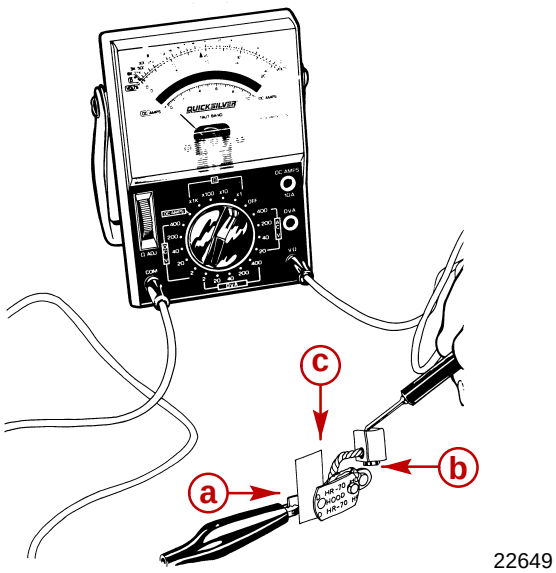
Zero ohms indicated (full continuity) - Proceed to next step.
Zero ohms not indicated (no continuity) - Replace thermal switch.



a - Thermal Switch Spade Connector
b - Brush Lead

2. Insert an insulator (piece of paper) between the contact points on the ohmmeter (between spade connector and brush lead).

Zero ohms indicated (full continuity) -Replace thermal switch.
Zero ohms not indicated (no continuity) - Thermal switch OK.

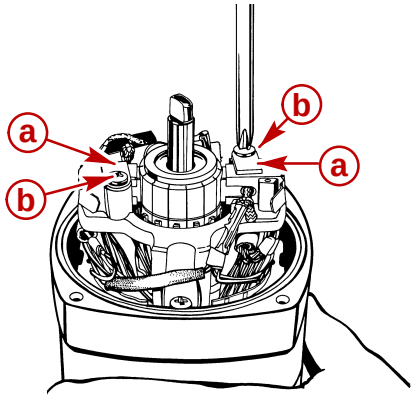


a - Thermal Switch Spade Connector
b - Brush Lead
c - Insulator (Piece of Paper)

3. Remove the insulator from between the contact points on the thermal switch. Clear all material away from the points.

Brush Replacement

1. Loosen the brush hold down arms.

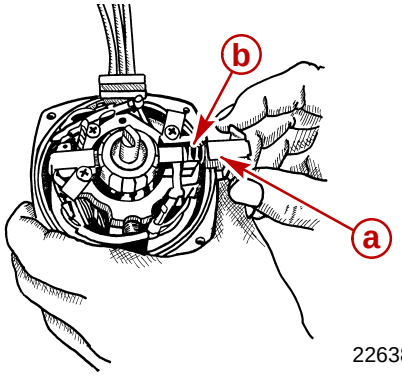


22648

a - Brush Hold Down Arms
b - Screws

IMPORTANT: Use care in removing brush holders so as not to lose springs.

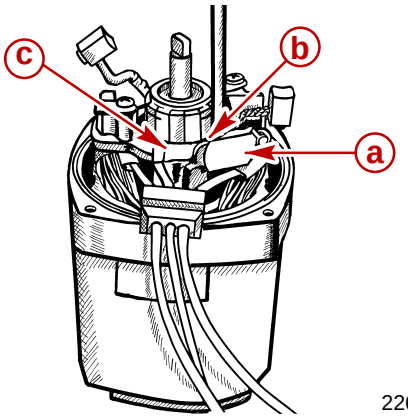
2. Remove the brush holders and springs.



22638

a - Brush Holder
b - Spring

3. Remove the thermal switch and brush assembly.



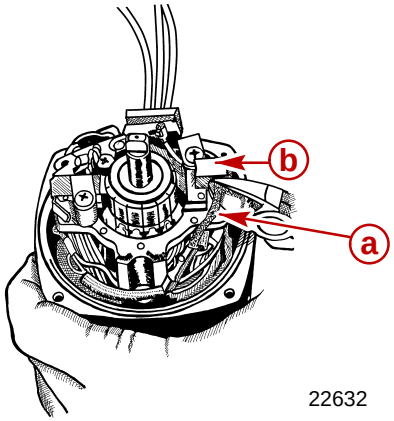
22637

a - Thermal Switch and Brush
b - Screw
c - Connector

Index

IMPORTANT: When replacing the brush that is connected to the field wires; cut the brush wire as close to the brush as possible.

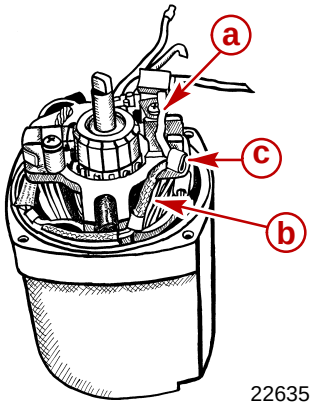
4. Cut the brush wire as close to the brush as possible and discard the brush.



22632

a - Brush Wire
b - Brush

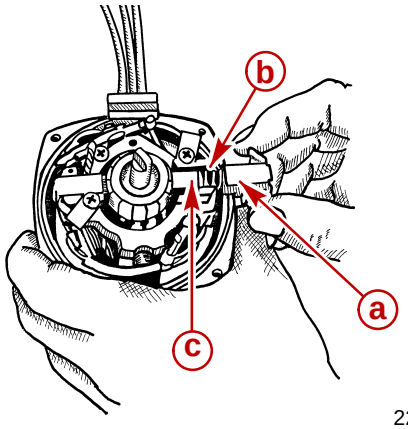
5. Connect the new brush wire to the field wire cut in the previous step. Secure by crimping both wires together as shown.



22635

a - Brush Wire
b - Field Wire (Old Brush Wire)
c - Crimp Connector

6. Reinstall the spring and brush in the brush holder.

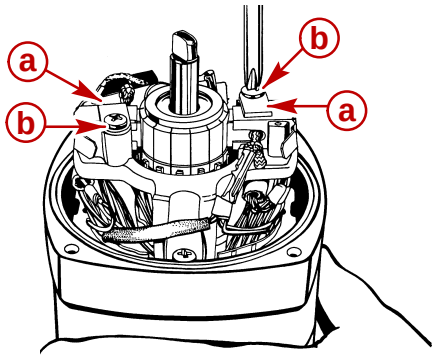


22638

a - Brush Holder
b - Spring
c - Brush

Index

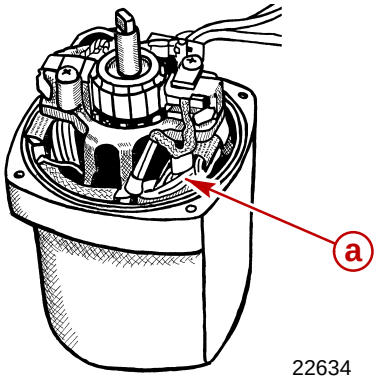
7. Position the brush hold down arms and tighten them securely. DO NOT OVERTIGHTEN.



22648

a - Brush Hold Down Arms
b - Screws

8. Position the brush wire as shown before reassembly.

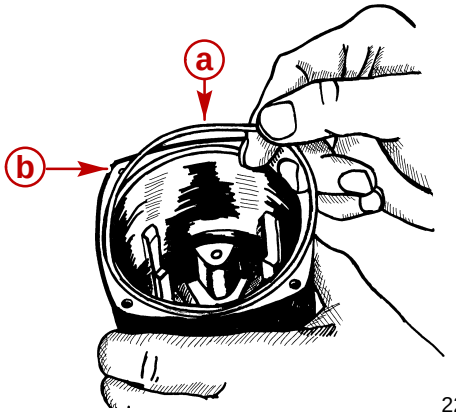


22634

a - Brush Wire

Reassembly

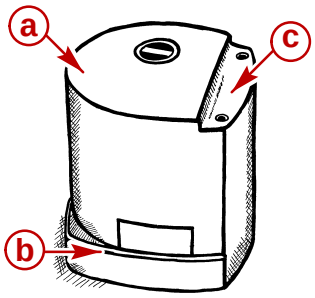
1. Install the motor housing O-ring.



22645

a - O-ring
b - Motor Housing

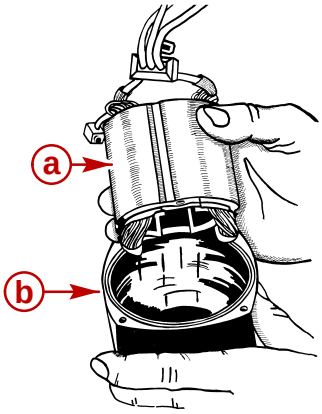
IMPORTANT: The field assembly wires must face the front of the motor housing. Use the notched area in the housing as a reference in determining the front.



22633

a - Motor Housing
b - Front
c - Notched Area

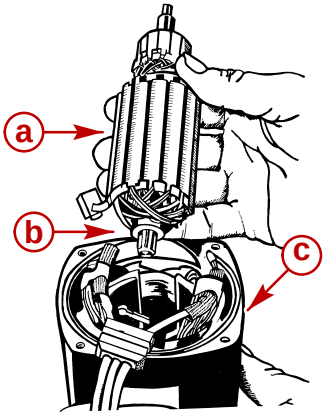
2. Install the field assembly into the motor housing.



22501

a - Field Assembly
b - Motor Housing

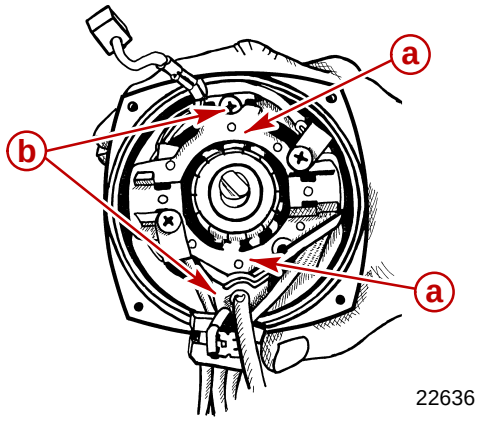
3. Install the thrust washer on the armature and install the armature into the motor housing.



22499

a - Armature
b - Thrust Washer
c - Motor Housing

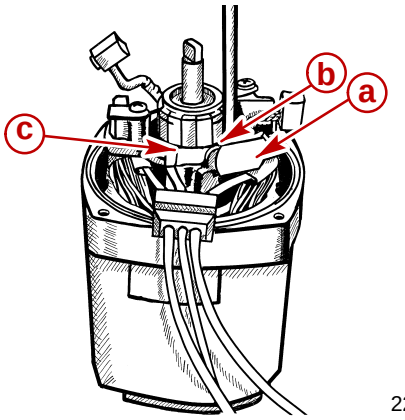
4. Install the brush assembly mounting. Tighten the screws securely.



22636

a - Brush Assembly Mounting Bracket
b - Screws

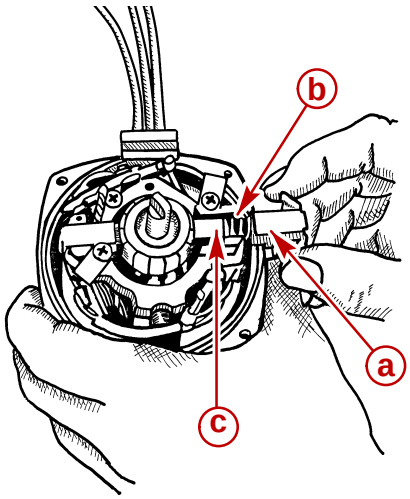
5. Install the thermal switch and connect the black wire. DO NOT overtighten the screw.



22637

a - Thermal Switch
b - Screw
c - Black Wire Connector

6. Install the springs and brushes in the brush holders.



22638

a - Brush Holders
b - Springs
c - Brushes

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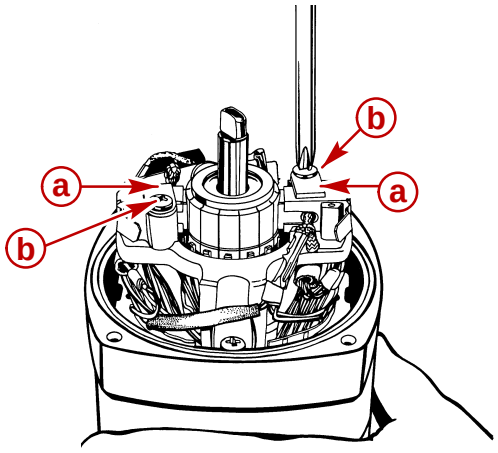
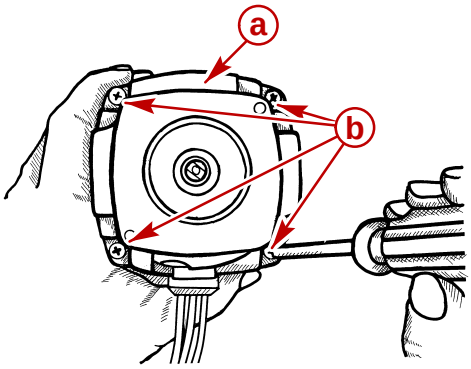
7. Position the brush holders and secure them with the brush hold down arms. DO NOT overtighten the screws.



22648

a - Brush Hold Down Arms
b - Screws

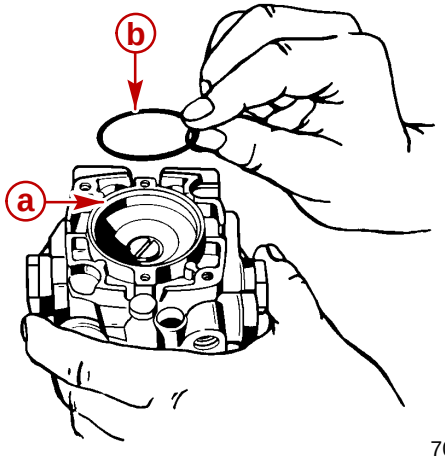
8. Install the motor end cover. Apply Loctite 27131 to the screws and tighten securely. DO NOT overtighten.



22639

a - Motor End Cover
b - Screws

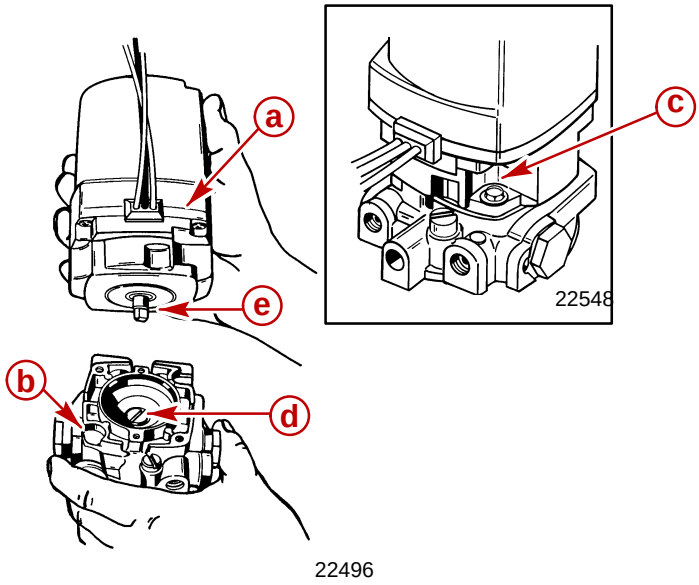
9. Install the motor to adapter O-ring.



70600

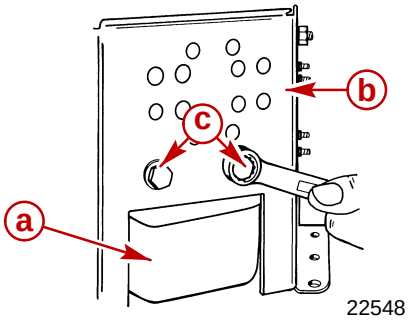
a - Adapter
b - O-ring

10. Align the motor shaft with the coupler and install the trim motor on the adapter. Torque the screws to 25 lb. in. (2.8 N·m).



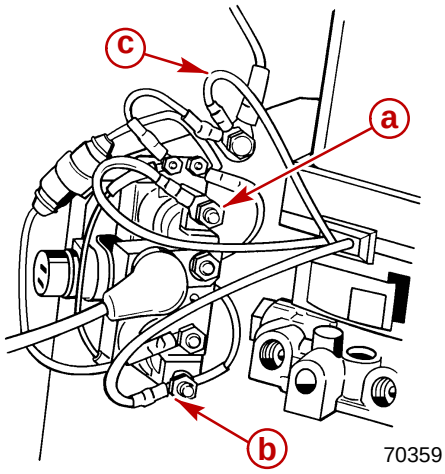
a - Trim Motor
b - Adapter
c - Screws (2 in Opposite Corners)
d - Coupler
e - Motor Shaft

11. Install the trim pump on the floor bracket. Tighten securely.



a - Trim Pump
b - Floor Bracket
c - Screws and Lock Washers

12. Connect the trim motor wires to solenoids as shown.

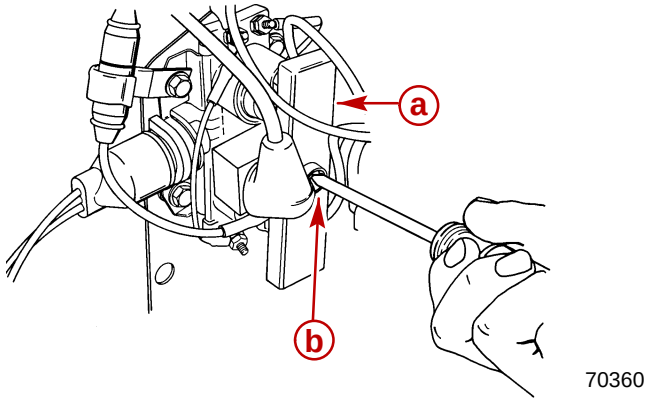


a - Blue/White Motor Wire
b - Green/White Motor Wire
c - Black Ground Wire

⚠ CAUTION

Solenoid terminal cover screw is attached to 12 volt positive source. DO NOT GROUND the screw driver when installing cover.

13. Install the solenoid terminal cover. Tighten the screw securely.



a - Solenoid Terminal Cover
b - Screw

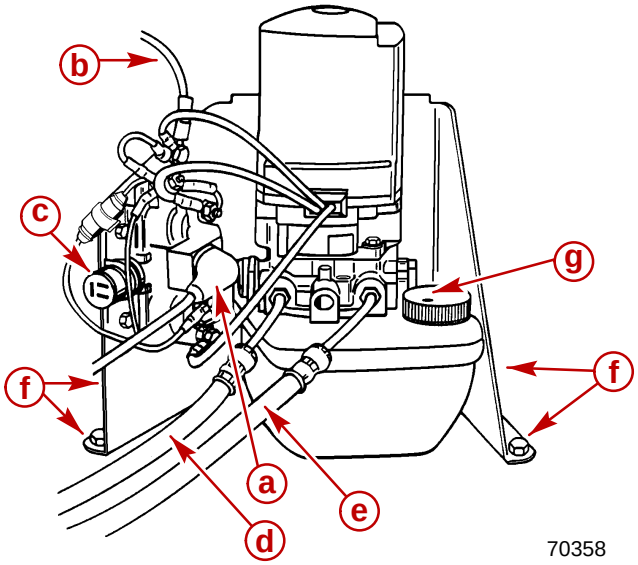
Trim Pump Installation

1. Secure the pump and mounting bracket to the boat using lag bolts and washers.
2. Reconnect the trim hoses to the pump; black hose to the left connection, gray hose to the right connection. DO NOT cross-thread or overtighten the hose fittings. Torque the fittings to 110 lb. in. (12 N·m).
3. Reconnect the trim harness connector to the trim pump.
4. Reconnect battery leads to battery.

⚠ CAUTION

Fill cap is vented. Be sure to remove “Caplug” (fill neck seal) from fill neck on new replacement pumps. Failure to do this can damage pump, when operated.

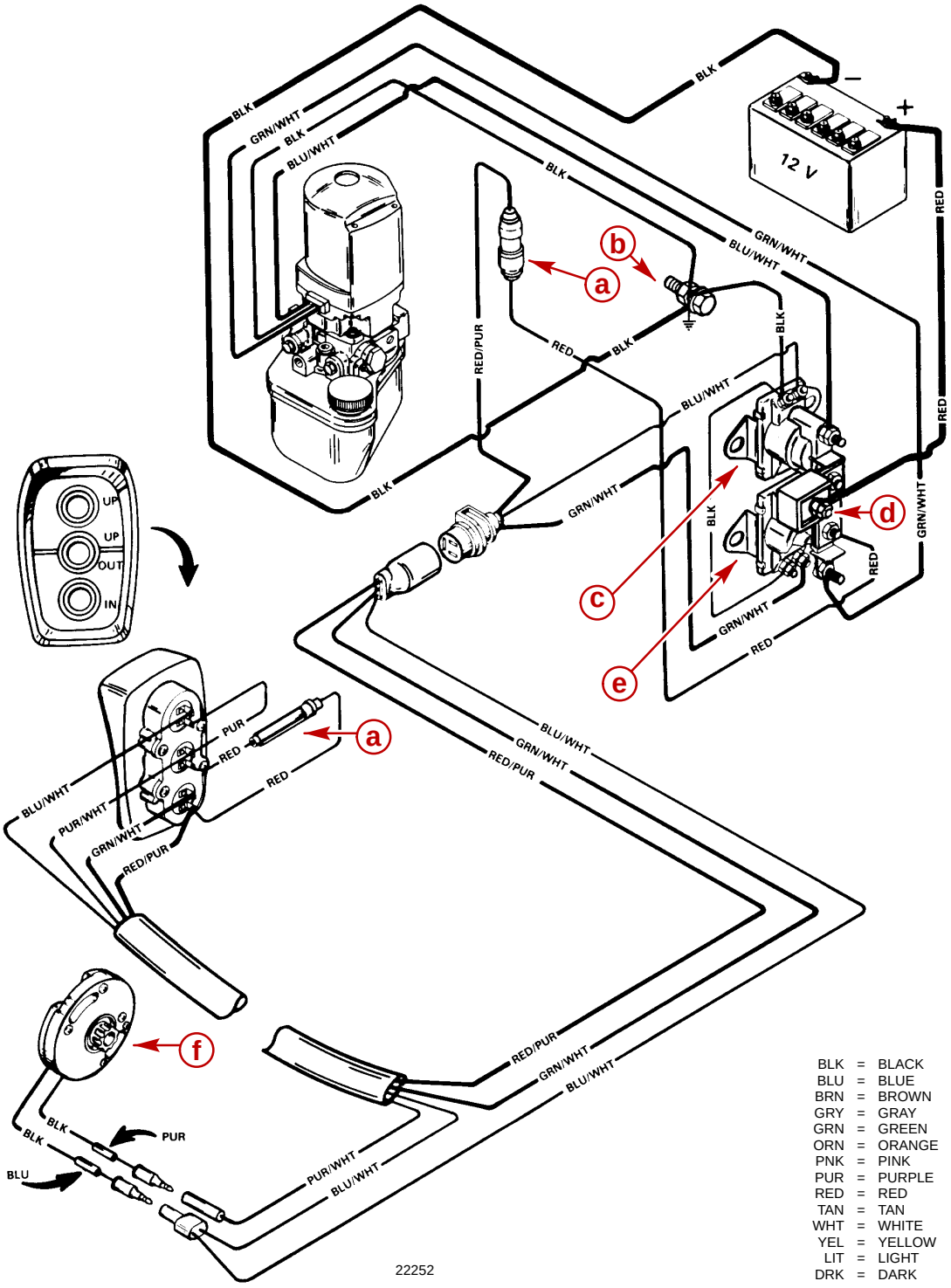
5. Check the fluid level and fill if necessary. (Refer to “Maintaining Power Trim Pump Oil Level” in this section).



70358

a - Positive Battery Lead
b - Negative Battery Lead
c - Harness Connector
d - Black Hydraulic Hose (UP Hose)
e - Gray Hydraulic Hose (DOWN Hose)
f - Lag Bolts and Washers
g - Vent Plug (Earlier Models; Replaced By a Vented Fill Cap)
h - Vent in the Vented Fill Cap

Trim Pump Wiring Diagrams



BLK = BLACK
BLU = BLUE
BRN = BROWN
GRY = GRAY
GRN = GREEN
ORN = ORANGE
PNK = PINK
PUR = PURPLE
RED = RED
TAN = TAN
WHT = WHITE
YEL = YELLOW
LIT = LIGHT
DRK = DARK

Model With Three-Button Trim/Trailer Panel

a - 20 Amp Fuse
b - Ground Bolt (Floor Mount)
c - UP Solenoid
d - DOWN Solenoid
e - Trim Limit Switch
f - 110 Amp Fuse

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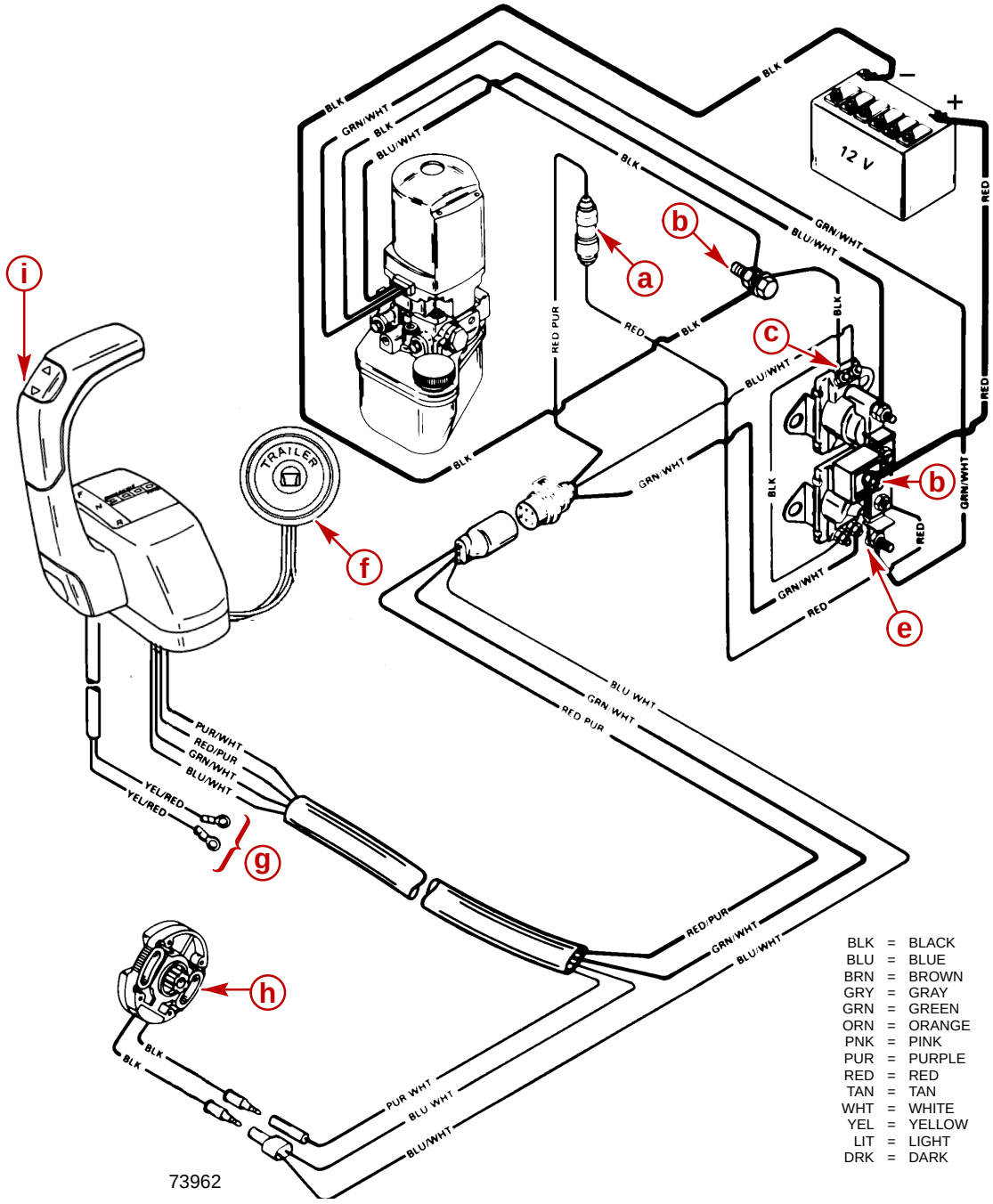
Model With Trim In Handle and Trailer Switch Separate



a - 20 Amp Fuse
b - Ground Bolt (Floor Mount)
c - UP Solenoid
d - 110 Amp Fuse
e - DOWN Solenoid
f - Trailer Switch
g - Neutral Switch to Instrument Wiring Harness
h - Trim Limit Switch
i - Trim Buttons

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POWER TRIM

Section 5B - Trim Cylinders

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B

Specifications

Torque Specifications

DESCRIPTION	TORQUE		
	lb. in.	lb. ft.	N·m
Piston Rod Bolt		15-20	20-27
End Cap		40-50	55-68
Anode Screw	30		3.4

Lubricants/Sealers/Adhesives

NOTE: *Prior to reassembly of trim cylinder(s), lubricate all internal parts with Quicksilver Power Trim and Steering Fluid or (if not available) 10W-30 or 10W-40 motor oil.*

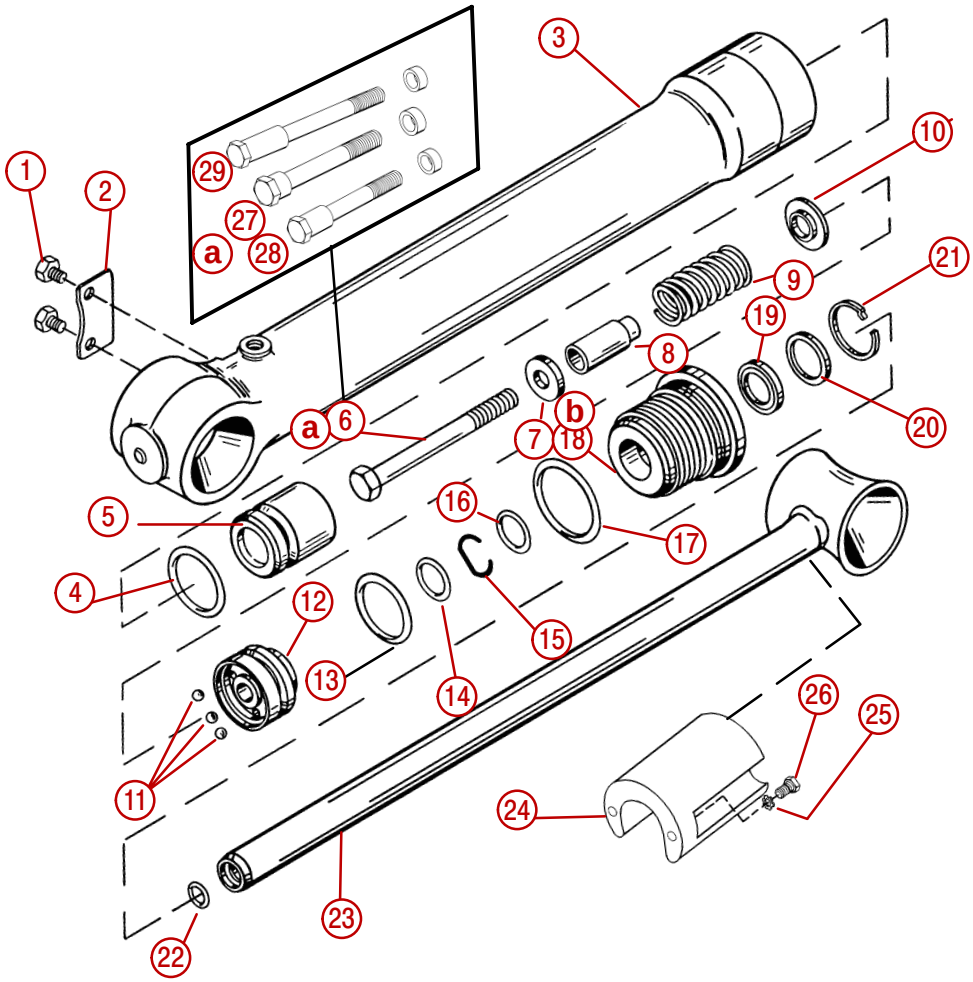
DESCRIPTION	PART NUMBER
Loctite 27131	92-809820
Quicksilver 2-4-C Marine Lubricant with Teflon	92-825407A12
Quicksilver Perfect Seal	92-34227--1
Quicksilver Power Trim and Steering Fluid	92-90100A12

Special Tools

DESCRIPTION	PART NUMBER
Spanner Nut Wrench	91-821709
Large Pin Set	91-811907
Medium Pin Set	91-811908
Small Pin Set	91-811909

Trim Cylinder Exploded Views

Bravo Trim Cylinders



73349

1 - Screws
2 - Clamping Plate
3 - Trim Cylinder
4 - O-Ring
5 - Floating Piston
6 - Bolt
7 - Washer
8 - Spring Guide
9 - Spring
10- Spring Guide Washer
11- Check Balls
12- Shock Piston
13- O-Ring
14- Small O-Ring
15- Continuity Spring
16- Small O-Ring
17- Large O-Ring
18- End Cap
19- Rod Scraper
20- Washer
21- Retaining Ring
22- Small O-Ring
23- Piston Rod
24- Anode
25- Star Washer
26- Screw
27- Trim-In Limit Spacers (1/4 in.)
28- Trim-In Limit Spacers (3/4 in.)
29- Trim-In Limit Spacers (1-1/4 in.)

LUBRICANTS/SEALERS/ADHESIVES

Lubricate all internal parts with Quicksilver Power Trim and Steering Fluid before reassembling

TORQUE SPECIFICATION

(a) 15-20 lb. ft. (20-27 N·m)

(b) 40-50 lb. ft. (55-68 N·m)

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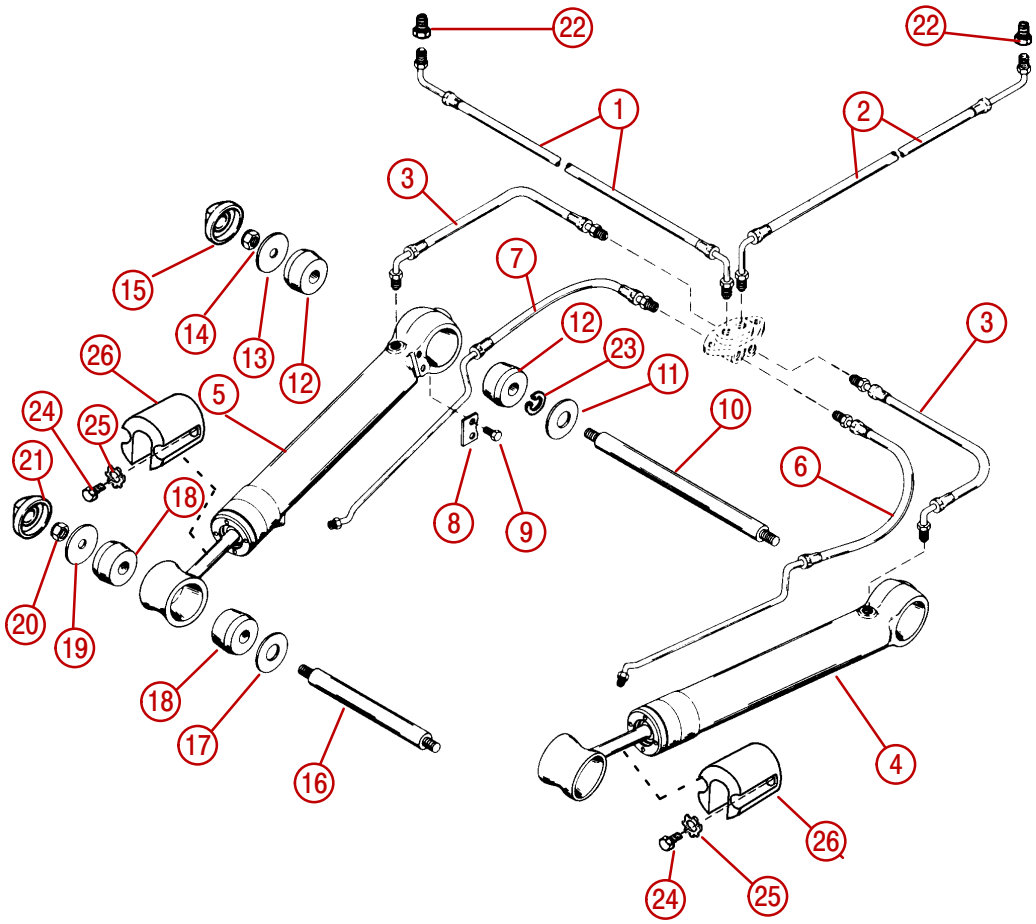
Bravo Trim System Components



73554

1 - "In"/"Down" Hose to Trim Pump (Gray)
2 - "Up"/"Out" Hose to Trim Pump (Black)
3 - Hose to Trim Cylinder
4 - Starboard Trim Cylinder
5 - Port Trim Cylinder
6 - Starboard Trim Cylinder Hose
7 - Port Trim Cylinder Hose
8 - Plate
9 - Screw
10- Front Pin
11- Washer
12- Bushing
13- Washer
14- Nut
15- Cap
16- Rear Pin
17- Washer
18- Bushing
19- Washer
20- Nut
21- Cap
22- Connector (Trim Pump)
23- Retainer
24- Screw
25- Continuity Washer
26- Trim Cylinder Anode

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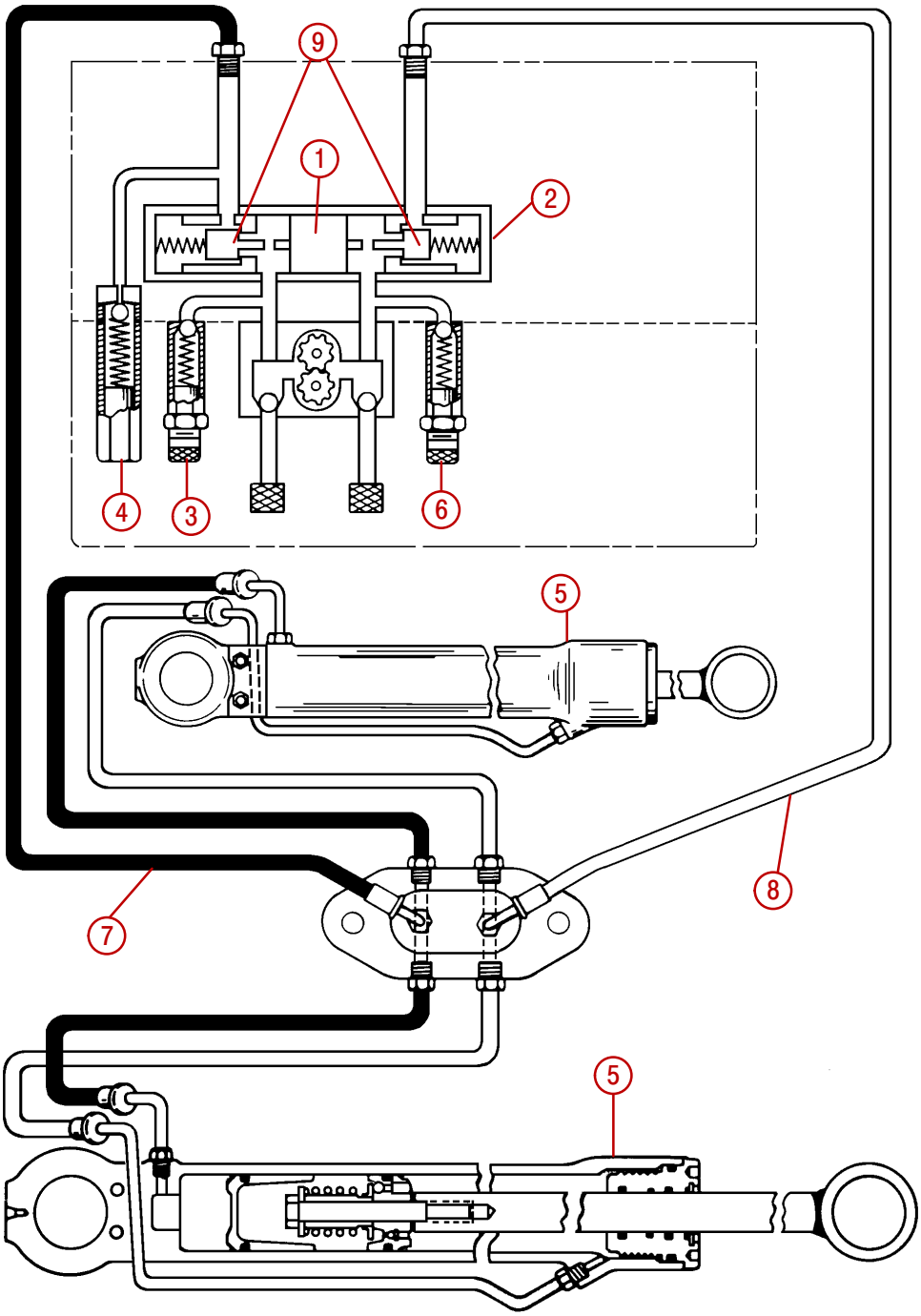
Power Trim Hydraulic Schematic



73552

1 - Shuttle
2 - Pump Adaptor
3 - Up/Out Pressure Relief Valve
4 - Thermal Relief Valve
5 - Trim Cylinder
6 - IN/Down Pressure Relief Valve
7 - Up/Out Hose
8 - IN/Down Hose
9 - Pilot Check Valves

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Special Information

Bravo Three Notice: Trim IN Limit Blocks or Limit Pin

NOTE: *Some earlier Bravo Three models will be equipped with Trim-In Limit Blocks, later model Bravo One, Two, and Three will have a Trim-In Limit Pin. Refer to Sec. 4A for information on Removal, Installation, or Adjustment of Trim-In Limit Blocks.*

It has been brought to our attention that some boats (predominantly deep-Vee heavy boats) will roll up on their side under certain, specific, operating conditions. The roll can be either to port or starboard and may be experienced while moving straight ahead, or while making a turn. The roll occurs most frequently at or near maximum speed, with the drive unit trimmed at or near full IN. While the boat will not roll completely over, the roll may be sufficient to unseat the operator or passengers, and thereby create an unsafe situation.

The roll is caused by “stern lift.” “Stern lift” can be created by excessive drive unit trim “In.” Under these extreme “stern lift”/“bow down” conditions instability can be created which may cause the boat to roll. Weight distribution to the stern can reduce “stern lift” and, in some circumstances, eliminate the condition. Weight distribution in the bow, port or starboard, may worsen the condition.

The Trim IN limit devices reduce “stern lift” by preventing the drive unit from reaching the last few degrees of full trim under. While this device should reduce the rolling tendency, they may not eliminate the tendency entirely. The need for these trim IN limit blocks or pin, and the effectiveness of them, can only be determined through boat testing and is ultimately the responsibility of the boat manufacturer.

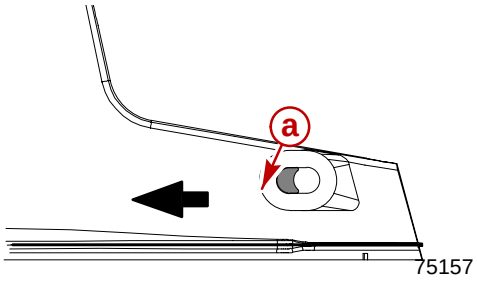
⚠ WARNING

It is recommended that only qualified personnel remove or adjust the Trim IN Limit Blocks or adjust the Trim-In Limit Pin. Boat must be water tested after removing or adjusting the device to ensure that the modified trim IN range does not cause the boat to exhibit an undesirable boat handling characteristic if the drive unit is trimmed IN at higher speeds. Increased trim IN range may cause handling problems on some boats which could result in personal injury.

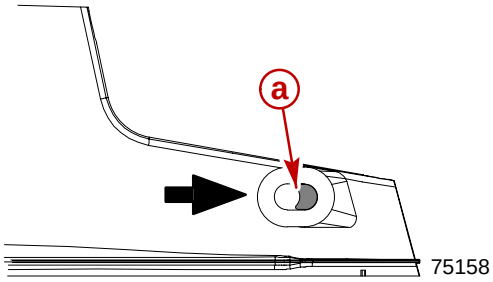
IMPORTANT: On Bravo One, Two, and Three Models, the “Trim-In Limit Pin” (If equipped), must be properly positioned before installing the trim cylinder anchor pin in the following steps.

NOTE: *When removing the sterndrive unit, make a note of the position of the pin for reference when reinstalling the drive unit.*

1. If equipped, ensure that the Trim-In Limit Pin is positioned as shown for the appropriate Bravo model.



Bravo One and Two (Positioned Forward)



Bravo Three (Positioned Aft)

a - Trim-In Limit Pin

IMPORTANT: The position of the Trim-In Limit Pin on the Bravo Three sterndrive unit should only be changed after the boat has been properly tested. Contact the boat manufacturer if you are not sure of the original position for a particular boat application.

Trim In Limit Blocks - Removal, Installation or Adjustment

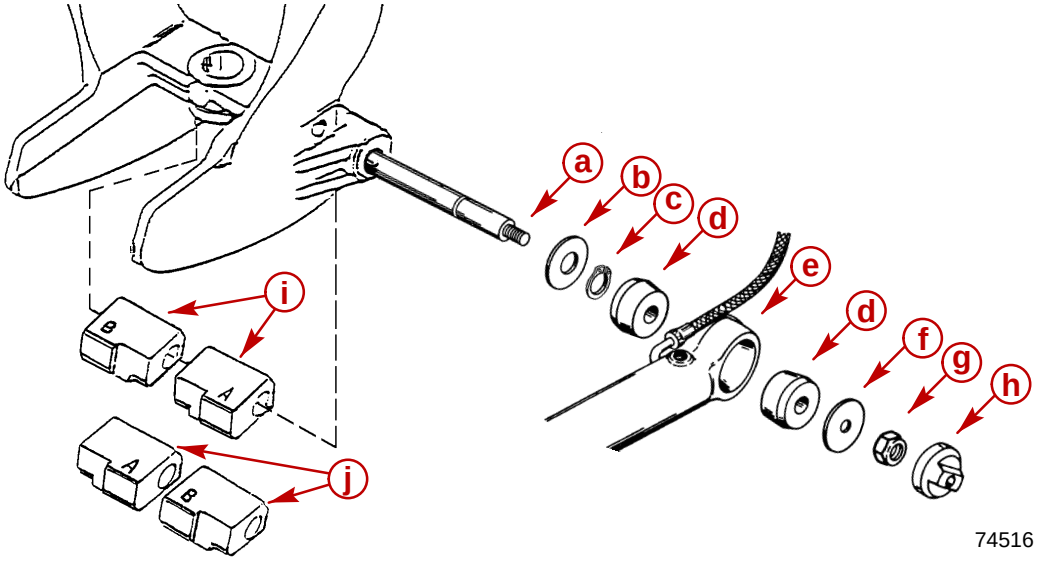
IMPORTANT: Prior to working on trim cylinders, make note of the position of Trim-In Limit Blocks, if so equipped.

⚠ CAUTION

Avoid transom/drive alignment error or interference, or casting damage. Always install Trim IN Limit Blocks with letters facing up (toward the gimbal ring clevis).

1. Disconnect the forward ends of both trim cylinders and remove the cylinders and their mounting hardware from the anchor pin. DO NOT disconnect the trim hoses.
2. Slide the anchor pin out of the gimbal ring. Follow instructions “a”, “b” or “c”:
   a. **To remove blocks:** Continue to slide anchor pin out until the trim limit blocks fall off of the pin.

b. **To Install or adjust blocks to be 3/4 in. (19mm) of trim IN limit**: Place block “A” on the port side and block “B” on the starboard side. Always install the blocks with the letter identifiers facing up (toward the gimbal ring clevis).



74516

a - Anchor Pin
b - Flat Washer (Large I.D.)
c - Snap Ring
d - Rubber Bushings (2)
e - Trim Cylinder
f - Flat Washer (Small I.D.)
g - Locknut
h - Plastic Cap
i - Limits The Trim IN by 1 in. (25 mm)
j - Limits the Trim IN By 3/4 In. (19mm)

c. **To Install or adjust blocks to be 1 in. (25mm) of trim IN limit**: Place block “B” on the port side and block “A” on the starboard side. Always install the blocks with the letter identifiers facing up (toward the gimbal ring clevis).

3. Follow appropriate instructions “a” or “b”:
   a. **After removal:** Push the anchor pin back through the gimbal ring.
   b. **After installation or adjustment:** Push the anchor pin through the Trim IN Limit Blocks and on through the gimbal ring.
4. Reinstall the trim cylinder(s) and mounting hardware.
5. Test the boat to ensure the proper trim IN limit was chosen.

NOTE: *If these Trim IN Limit Blocks do not provide the proper trim IN that is required for your application, the following Quicksilver kits are available (DO NOT use Trim IN Limit Blocks with the following kits). The following kits require internal changes to the trim cylinders.*

23-806445A3 - Trim IN Limit Spacer Kit - Limits Trim IN by 1/4 or 1/2 in.
23-806445A2 -Trim IN Limit Spacer Kit - Limits Trim IN by 1-1/4 or 1-1/2 in.

Trim Cylinder Internal Leak Test

Refer to Power Trim Pump Sec. 5A.

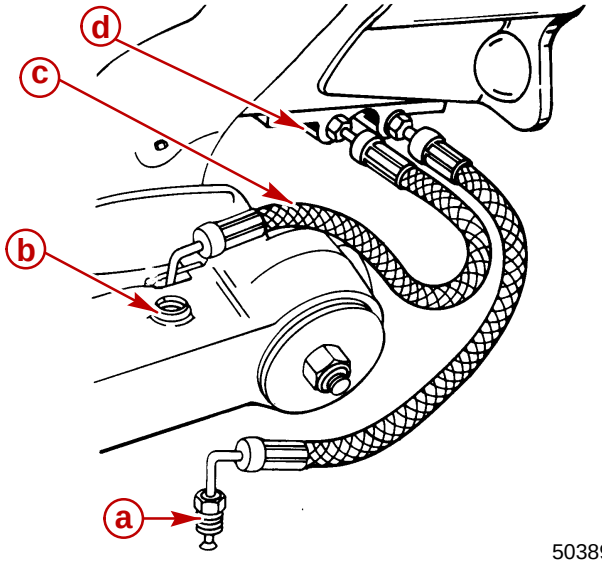
Trim Cylinder Shock Piston Test

Refer to Power Trim Pump Sec. 5A.

Trim Cylinder Repair

Removal

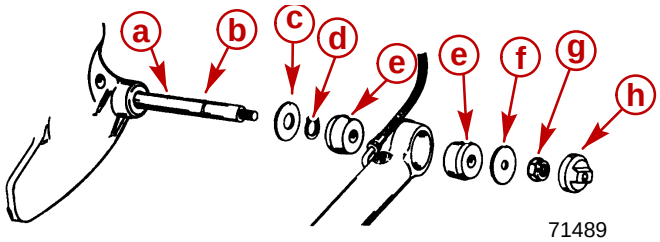
1. Disconnect “Up” trim hose from front hole on trim cylinder.
2. Disconnect “Down” trim hose from hydraulic connector on gimbal housing. Plug holes with suitable plug or (P/N 22-38609). Cap hoses.



50389

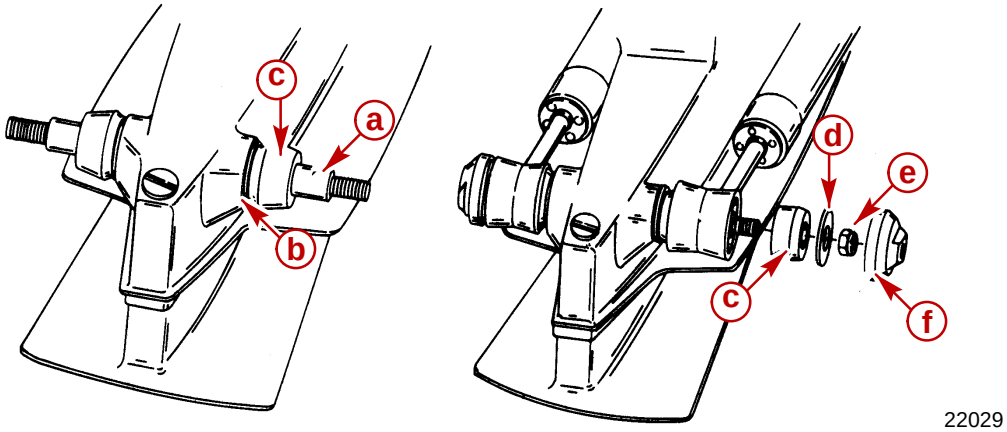
a - “Up” Hose
b - Front Hole on Trim Cylinder
c - “Down” Hose
d - Hydraulic Connector

3. Remove front and rear power trim cylinder mounting hardware.



71489

a - Anchor Pin (1)
b - Slots (2)
c - Flat Washer (Large I.D.) (2)
d - Snap Rings (2)
e - Rubber Bushings (4)
f - Flat Washer (Small I.D.) (2)
g - Locknut (2)
h - Plastic Cap (2)



22029

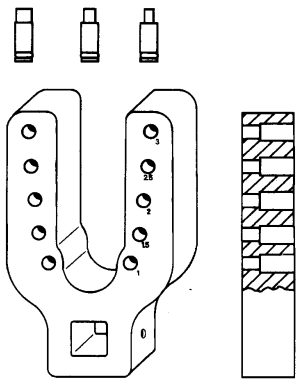
a - Rear Anchor Pin
b - Large I.D. Washers (Port and Starboard)
c - Rubber Bushings (2) (Port and Starboard)
d - Small I.D. Washers (Port and Starboard)
e - Locknuts (Port and Starboard)
f - Plastic Caps (Port and Starboard)

Disassembly

⚠ CAUTION

Ensure work area is clean before disassembling power trim cylinders. Cylinder parts can be damaged by dirt entering into power trim system.

NOTE: *Spanner Wrench Tool Part No. 91-821709.*

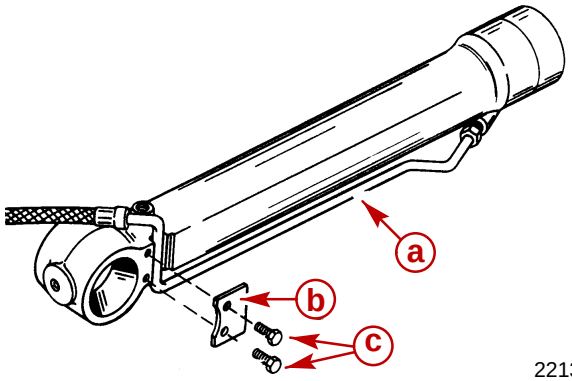


71233

⚠ CAUTION

DO NOT clamp center section of power trim cylinder during assembly or disassembly. Clamp cylinder on front mounting flange.

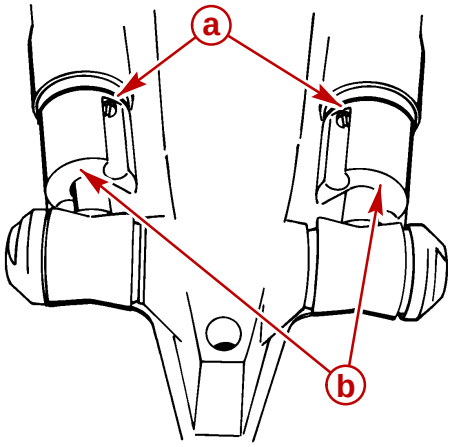
1. Remove “Down” trim hose from cylinder.



22134

a - “Down” Trim Hose
b - Clamping Plate
c - Screws

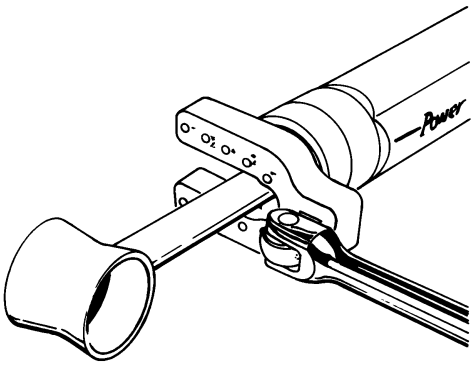
2. If equipped, remove trim cylinder anodes.



71966

a - Screws
b - Trim Cylinder Anodes

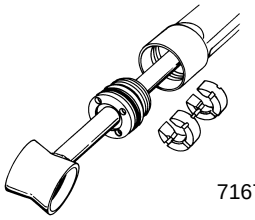
3. Remove trim cylinder end caps (Use special tool 91-821709).



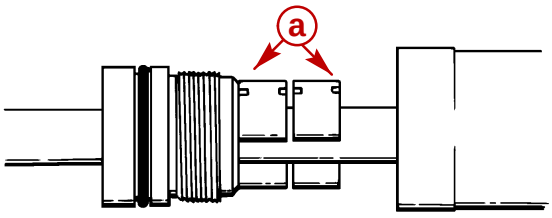
71677

NOTE: *Some boat configurations may require tilt-limit spacers to limit the total upward travel of the drive unit. Be sure to make note of the number of spacers used when disassembling. There must be an equal number in each cylinder.*

4. If Equipped, remove tilt-limit spacers.



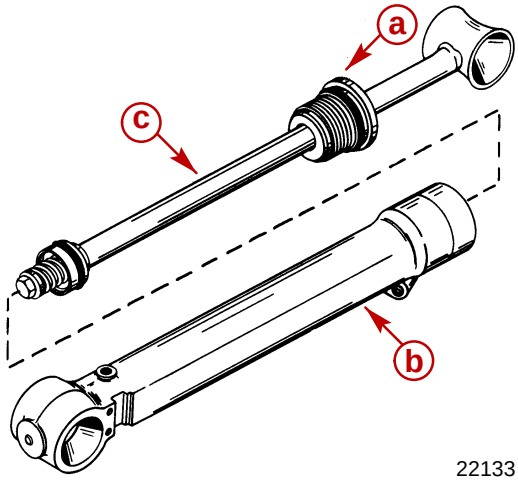
71678



71679

a - Tilt Limit Spacers

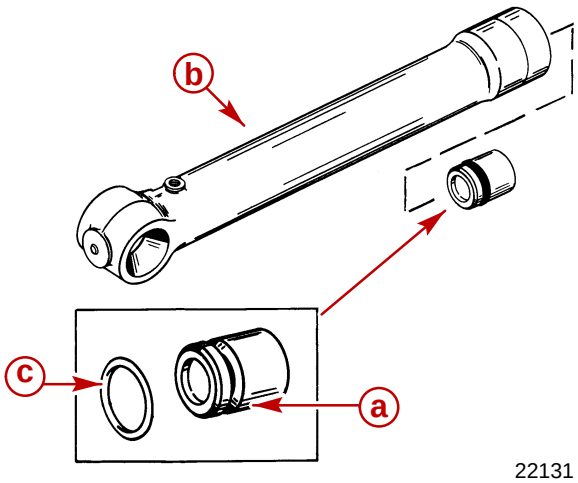
5. Remove piston rod assembly from cylinder.



22133

a - End Cap
b - Cylinder
c - Piston Rod Assembly

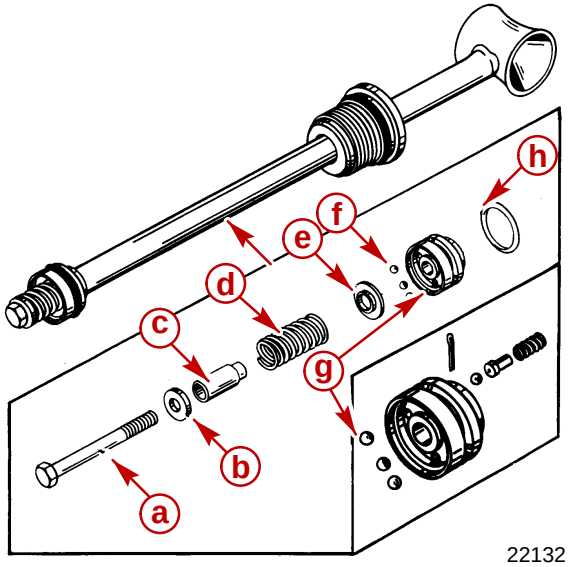
6. Remove floating piston from cylinder and remove O-ring.



22131

a - Floating Piston
b - Trim Cylinder
c - O-ring

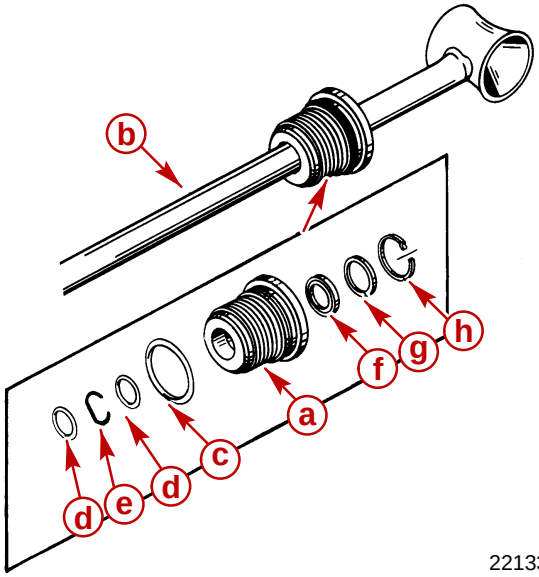
7. Remove and disassemble shock piston assembly. Be careful not to lose check balls.



22132

a - Bolt
b - Flat Washer
c - Spring Guide
d - Spring
e - Spring Guide Washer
f - Check Balls (3)
g - Shock Piston Assembly
h - O-ring

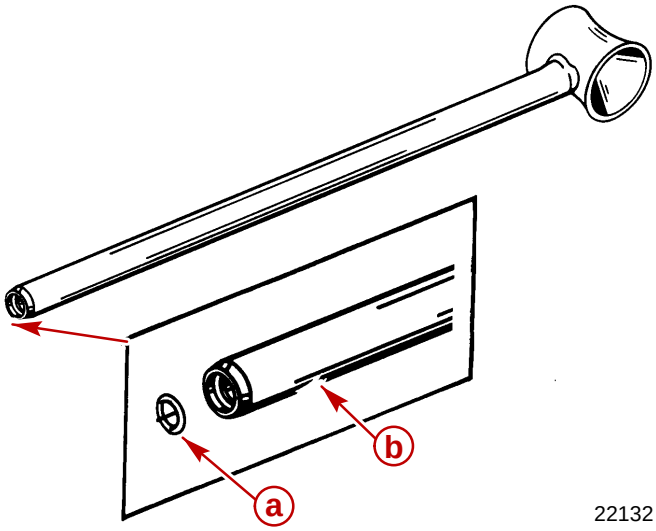
8. Remove and disassemble end cap.



22133

a - End Cap
b - Piston Rod
c - Large O-ring
d - Small O-ring (2)
e - Continuity Spring
f - Rod Scraper
g - Plain Washer
h - Retaining Ring

9. Remove small O-ring from end of piston rod.



a - Small O-ring
b - Piston Rod

10. Clean all parts in solvent. Be sure all parts are dry before reassembly.

Reassembly

IMPORTANT: Later model Alpha One drive units use a trim cylinder that is 3/4 in. (19mm) longer, to achieve 6° additional tilt. Earlier model R, MR, and Alpha One, as well as Bravo drive units, use the shorter trim cylinder. DO NOT attempt to substitute trim cylinders or damage to drive unit and/or transom assembly could result.

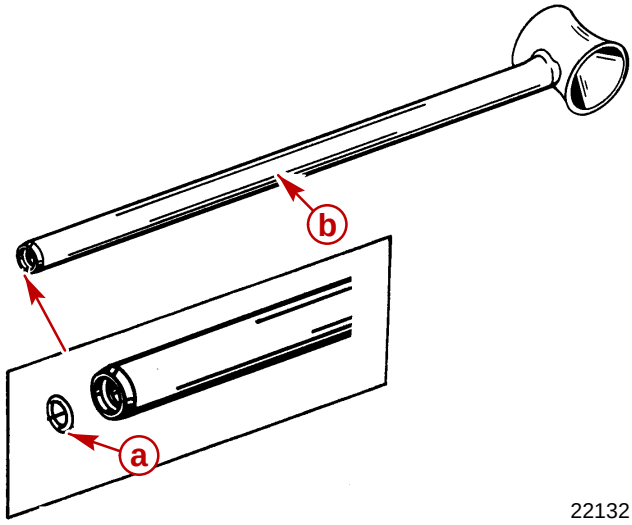
Trim cylinders can be identified by a casting number on inboard side of trim cylinder.

Shorter Cylinder: 98703, 98704
98703--1, 98704--1

Longer Cylinder: 14034--1, 14035--1

⚠ CAUTION
Ensure work area and all components are clean before reassembling trim cylinders. Power Trim components can become damaged if dirt gets into system.

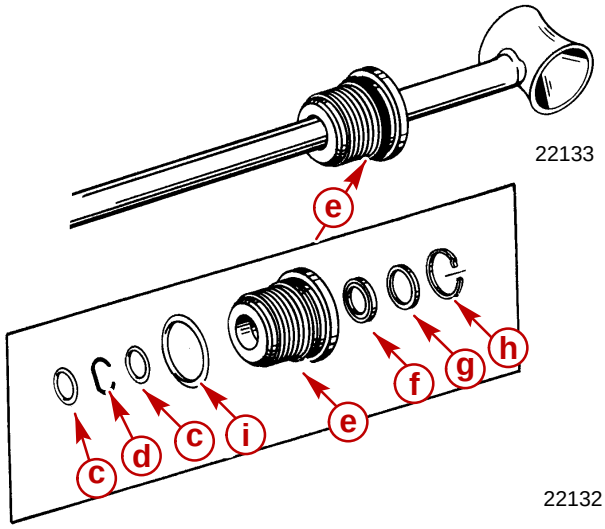
1. Install small O-ring into end of piston rod.



22132

a - Small O-ring
b - End of Piston Rod

2. Install small O-rings and continuity spring into end cap.
3. Install rod scraper, plain washer, and retaining ring into end cap.
4. Install large O-ring onto outside diameter of end cap.
5. Install end cap onto piston rod.



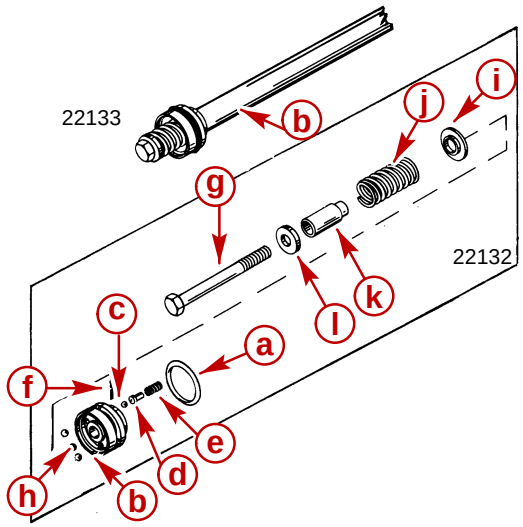
22133

22132

c - Small O-rings
d - Continuity Spring
e - End Cap
f - Rod Scraper
g - Plain Washer
h - Retaining Ring
i - Large O-ring

6. Install large O-ring on shock piston.
7. Install check ball, check ball eyelet, spring and spring pin into shock piston.
8. Apply Loctite 27131 to threads of bolt being used in the following step.

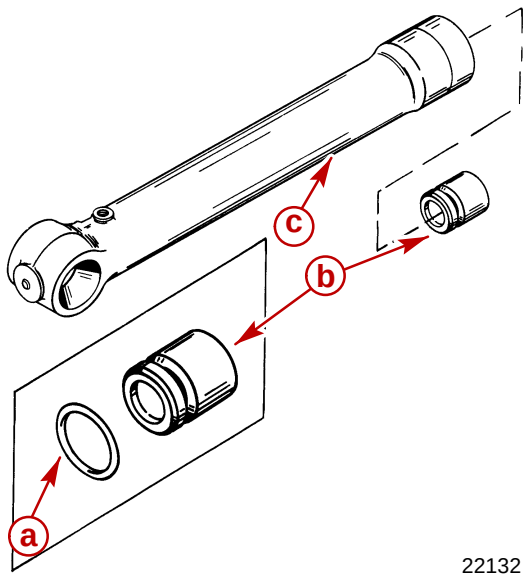
9. Install shock piston, three check balls, spring guide washer, spring, spring guide, spring guide washer and bolt onto piston rod. Torque to 15-20 lb. ft. (20-27 N·m).



a - Large O-ring
b - Shock Piston
c - Check Ball
d - check Ball Eyelet
e - Spring
f - Spring Pin
g - Bolt
h - Check Balls
i - Spring Guide Washer
j - Spring
k - Spring Guide
l - Spring Guide Washer

NOTE: *Before installing floating piston into cylinder, lubricate all internal parts with Quicksilver Power Trim and Steering Fluid or SAE 10W-30 or 10W-40 motor oil.*

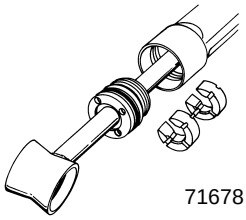
10. Apply oil to parts. Install O-ring onto floating piston and insert floating piston into cylinder.

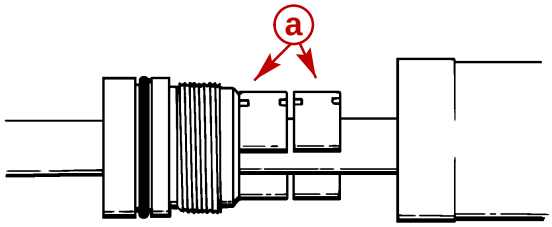


a - O-ring
b - Floating Piston
c - Cylinder

IMPORTANT: Some boat configurations may require tilt-limit spacers to limit the total upward travel of the drive unit. Be sure to install the same number of spacers that were originally removed. There must be an equal number in each cylinder.

11. If required, install tilt-limit spacers.


71678



71679

a - Tilt Limit Spacers

⚠ CAUTION

Ensure work area and all components are clean before reassembling trim cylinders. Power Trim components can become damaged if dirt gets into system.

NOTE: *Before reassembly, lubricate all internal parts with Quicksilver Power Trim and Steering Fluid or SAE 10W-30 or 10W-40 motor oil.*

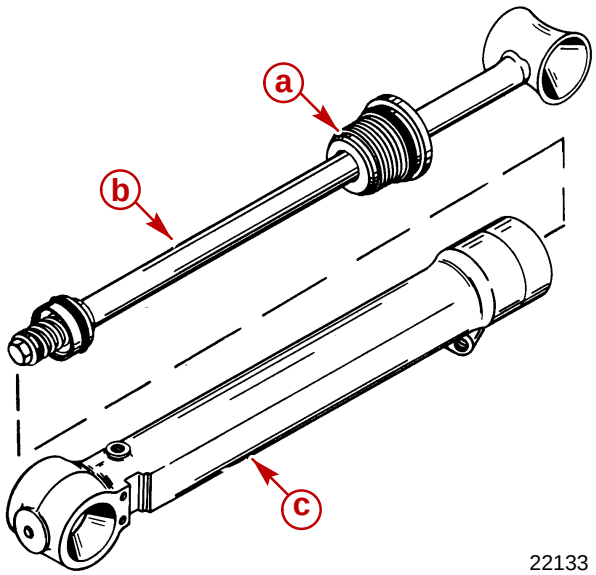
⚠ CAUTION

DO NOT clamp center section of trim cylinder during reassembly. If clamping of cylinder is necessary, clamp cylinder on front mounting flange.

⚠ CAUTION

Use only 2-4-C Marine Lubricant with Teflon on end cap threads. Other substances may act as an insulator and cause poor electrical continuity between cap and cylinder which could cause a corrosion problem.

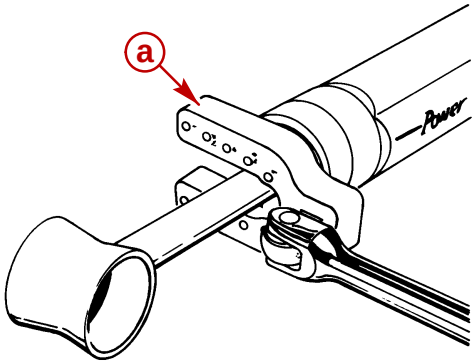
12. Apply 2-4-C Marine Lubricant with Teflon to end cap threads and install piston rod assembly into cylinder.



22133

a - End Cap
b - Piston Rod
c - Cylinder

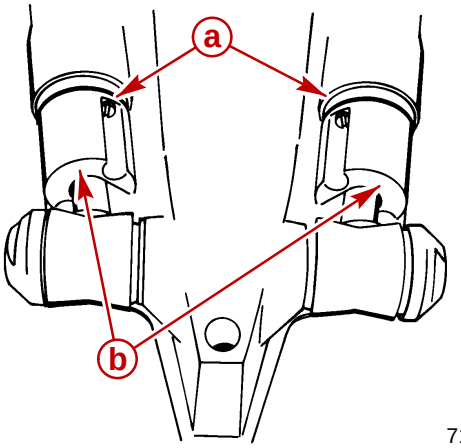
13. Using Spanner Wrench Tool P/N 91-821709, torque end cap 40-50 lb. ft. (55-68 N·m).



71677

a - Spanner Wrench

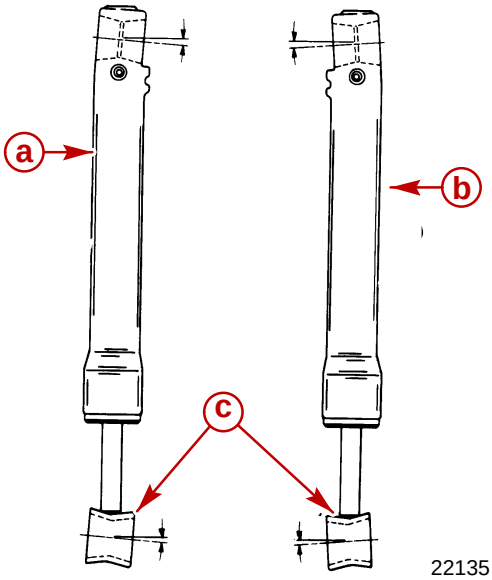
14. If equipped, install trim cylinder anodes.



71966

a - Screws (2 Each)
b - Anode (Each Trim Cylinder)

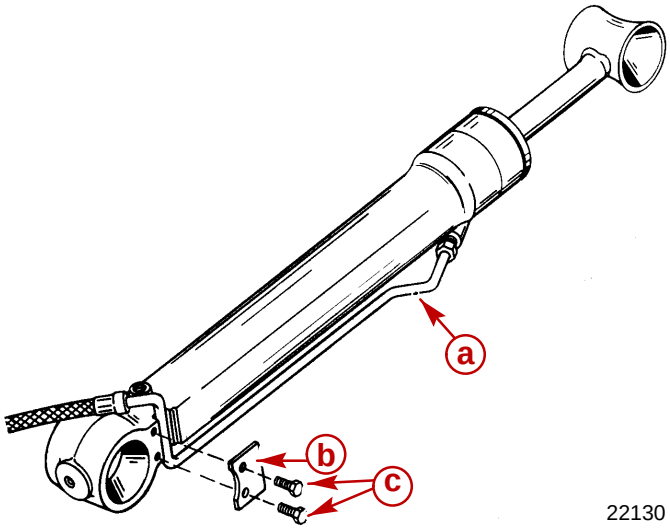
15. Position trim cylinder rear connecting ends as shown.



22135

a - Port Trim Cylinder
b - Starboard Trim Cylinder
c - Connecting Ends (Angled as Shown)

16. Install “Down” trim hose.



22130

a - “Down” Trim Hose
b - Clamping Plate
c - Screws

17. Check painted areas of trim cylinders for scratches that expose metal, paint if necessary.

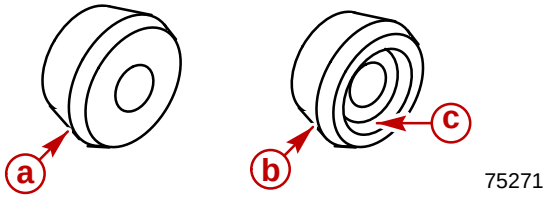
Installation

⚠ CAUTION

Use water and soap solution to aid in installing rubber bushings. The use of a petroleum based product (oil or grease) can deteriorate rubber.

NOTE: *Refer to “Special Information” at the front of this section before reinstalling trim cylinders.*

NOTE: *The bushings on Later Bravo drive units are made from a different type of material. The later style is harder. The bushing can also be identified by a small indentation on the outside face of the bushing. Do not mix the earlier style rubber bushings with the later style.*

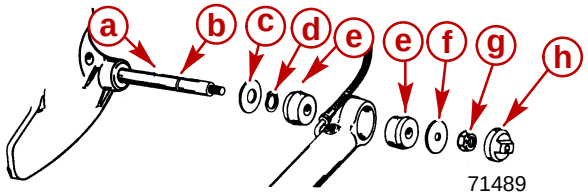


75271

a - Earlier Style Bushing
b - Later Style Bushing
c - Indentation on Later style

1. Install trim cylinder forward mounting hardware as shown.
2. Coat anchor pin threads with 2-4-C Marine Lubricant with Teflon (to prevent threads from galling).

3. Hand thread locknuts onto pin. DO NOT tighten at this time.

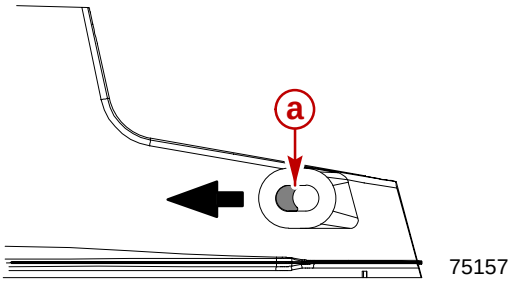


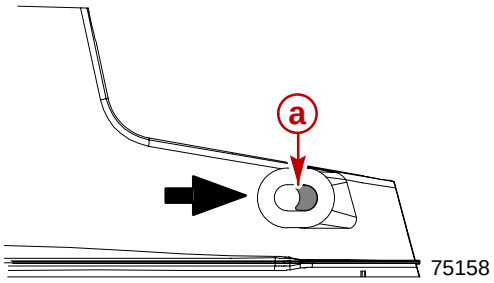
a - Anchor Pin (1)
b - Slots (2)
c - Flat Washer (Large I.D.) (2)
d - Snap Rings (2)
e - Rubber Bushings (4)
f - Washers (Small I.D.) (2)
g - Locknut (2)
h - Plastic Cap (2)

IMPORTANT: <u>On Bravo One, Two, and Three Models,</u> the "Trim-In Limit Pin" (If equipped), must be properly positioned before installing the trim cylinder anchor pin in the following steps.

NOTE: *Ensure that the Trim-In Limit Pin is reinstalled in the same position that is was in prior to removal of the sterndrive unit. If you are not sure of it's original position, contact the boat manufacturer for their recommendation. Refer to Special Information at the front of this section before reinstalling the Trim-In Limit Pin.*

4. If equipped, ensure that the Trim-In -Limit Pin is positioned as shown for the appropriate Bravo model.



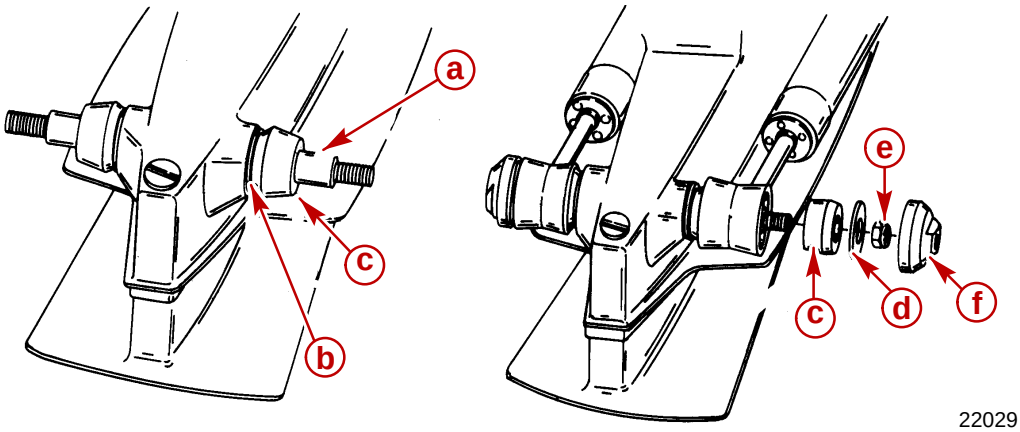


Bravo One and Two (Positioned Forward) **Bravo Three (Positioned Aft)**

a - Trim-In Limit Pin

IMPORTANT: The position of the Trim-In Limit Pin on the Bravo Three sterndrive unit should only be changed after the boat has been properly tested. Contact the boat manufacturer if you are not sure of the original position for a particular boat application.

5. Install trim cylinder aft mounting hardware as shown.
6. Coat anchor pin threads with 2-4-C Marine Lubricant with Teflon to prevent threads from galling.
7. Hand thread locknuts onto anchor pin. Install plastic caps.



22029

a - Aft Anchor Pin (Shorter)
b - Washers (2) - Large I.D.
c - Rubber Bushings
d - Washers (2) - Small I.D.
e - Locknuts (2)
f - Plastic Caps (2)

⚠ CAUTION

All 4 anchor pin locknuts must be tightened as described following or damage to sterndrive unit may result from drive unit moving too far inward.

8. Tighten 4 anchor pin locknuts until nuts and washers bottom out against anchor pin shoulder.
9. Reconnect trim hoses after air bleeding power trim cylinders and hoses following procedures outlined in Section 5A.

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POWER TRIM

Section 5C - Dual Power Trim System

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5C

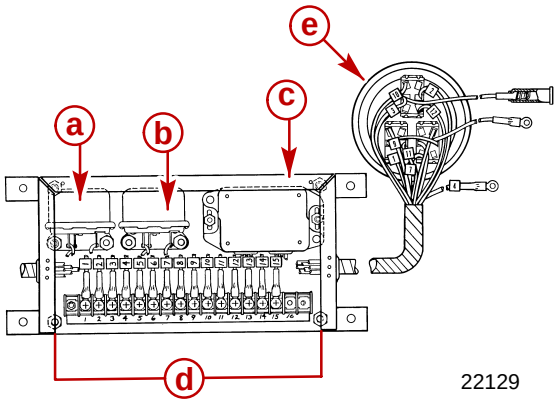
Important Information

When testing this Dual Power Trim system, take special note of the following:

1. The control box harness connectors must be disconnected and the key switch must be “OFF.”
2. Make certain that the jumper lead used between terminals 3 and 5 is used only when specified.

The following tests are listed in order of probable component failure. It is recommended, however, that all tests be performed even if a faulty component is detected early in the sequence. This precaution will guard against repeat failure if there is more than one failed component.

Testing Dual Power Trim System



Dual Trim Control Panel Electrical Box

a - Relay No. 1
b - Relay No. 2
c - Diode Module
d - Terminal Block
e - Control Panel

Relay Test

1. **Testing Relay No. 1**

   a. Test for 12 volts at terminal 2, using only terminal 4 as a ground.

- Voltage indicated, proceed to “b.”
- No voltage indicated, replace relay.

   b. Connect a jumper wire between terminals 3 and 5. Test for 12 volts at terminal 2, using only terminal 4 as a ground.

- No voltage indicated, relay OK.
- Voltage indicated, replace the relay.

Index

2. **Testing Relay No. 2**

   a. Test for continuity between terminals 13 and 9.

- Continuity indicated, proceed to “b.”
- No continuity indicated, replace the relay.

   b. Connect a jumper wire between terminals 3 and 5. Test for continuity between terminals 13 and 9.

- No continuity indicated, relay OK.
- Continuity indicated, replace relay.

Diode Module Test

Perform the following diode tests using an ohmmeter set on the Rx1 scale. When testing diodes, take 2 readings. Note the first reading; then, reverse the meter leads and, again, note the reading.

If the diode is good, the meter should indicate a high or infinite resistance (no meter movement) when connected one way and a low reading (below 60 ohms) when connected the other way.

If both readings are high or infinite, the diode is open. Replace the diode module.

Diode No. 1

Connect a jumper wire between terminals 3 and 5. Test the diode between terminals 9 and 10.

Diode No. 2

Connect a jumper between terminals 3 and 5. Test diode between terminals 10 and 13.

⚠ CAUTION

Before proceeding with further diode testing, remove fuse from red/purple harness lead so that it will not be possible to short either control box or VOA meter.

Diode No. 3

Test the diode between terminals 6 and 12.

Diode No. 4

Test the diode between terminals 12 and 7.

Diode No. 5

Test the diode between terminals 8 and 11.

Diode No. 6

Test the diode between terminals 14 and 15.

Diode No. 7

Test the diode between terminals 8 and 5.

Diode No. 8

Test the diode between terminals 5 and 15.

Trailer Switch Test

⚠ CAUTION

Remove fuse from red/purple harness lead before proceeding with test.

1. Set the ohmmeter on the Rx1 scale.
2. Push down on the “Trailer” switch and check for continuity between terminals 10 and 3.
   - Continuity indicated, proceed to step 3.
   - No continuity indicated, replace the switch.
3. Push up on the trailer switch and check for continuity between terminals 2 and 12.
   - Continuity indicated, switch OK.
   - No continuity indicated, replace the switch.

Starboard Trim Switch Test

1. Set ohmmeter on Rx1 scale.
2. Push down on “STBD TRIM” switch and check for continuity between terminals 1 and 9.
   - Continuity indicated, proceed to step 3.
   - No continuity indicated, replace switch.
3. Push up on “STBD TRIM” switch and check for continuity between terminals 11 and 6.
   - Continuity indicated, switch OK.
   - No continuity indicated, replace switch.

Port Trim Switch Test

1. Set ohmmeter on Rx1 scale.
2. Push down on “PORT TRIM” switch and check for continuity between terminals 2 and 13.
   - Continuity indicated, proceed to step 3.
   - No continuity indicted, replace switch.
3. Push up on “PORT TRIM” switch and check for continuity between terminals 14 and 7.
   - Continuity indicated, switch OK.
   - No continuity indicated, replace switch.

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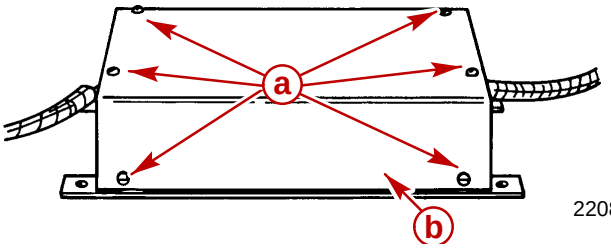
Dual Power Trim System Component Repair

Important Information

Use care when removing and installing components. Do not force or pull wiring during replacement. Use care to prevent wiring from stretching, pinching or chafing. Coat all terminal connections with Liquid Neoprene.

Relay Replacement

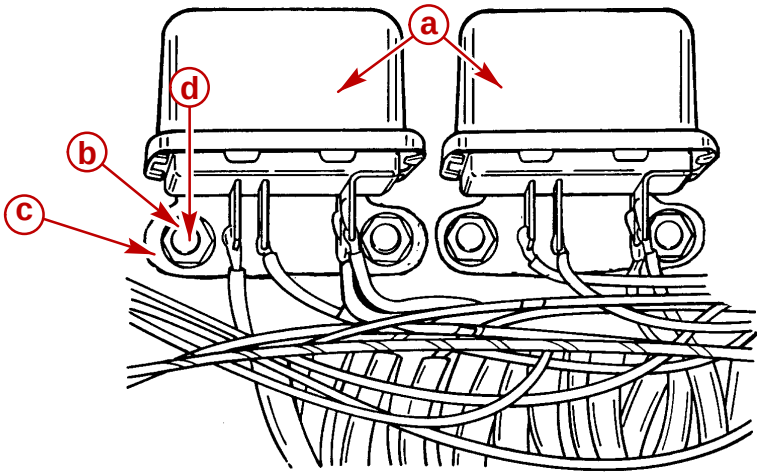
1. Remove control box cover.



22086

a - Screws
b - Cover

2. Unsolder wires from relay to be replaced.
3. Remove relay.



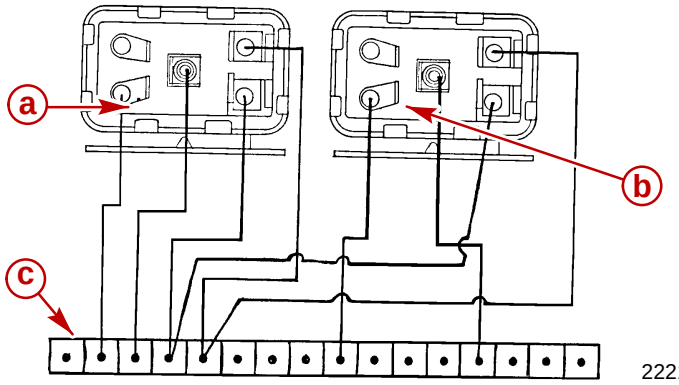
22086

a - Relay Assemblies (1 and 2)
b - Nuts
c - Washers
d - Screws

4. Install new relay.

IMPORTANT: Use 63/67 (Tin/Lead) alloy solder. DO NOT use acid core solder as damage to relay can result. Coat terminal connections with Quicksilver Liquid Neoprene (92-25711).

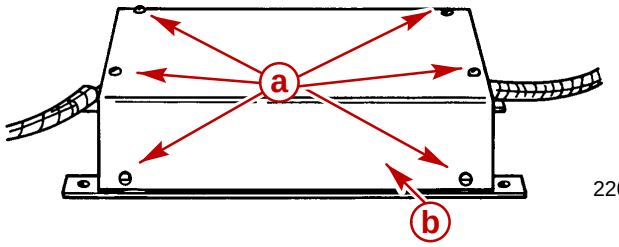
5. Resolder wires from terminal block to relay as shown.
6. Coat terminal connections with Quicksilver Liquid Neoprene (92-25711).



22216

a - Relay No. 1
b - Relay No. 2
c - Terminal Block

7. Install control box cover.



22086

a - Screws
b - Cover

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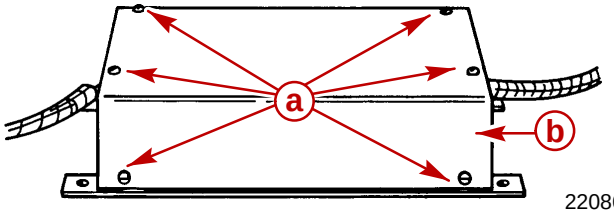
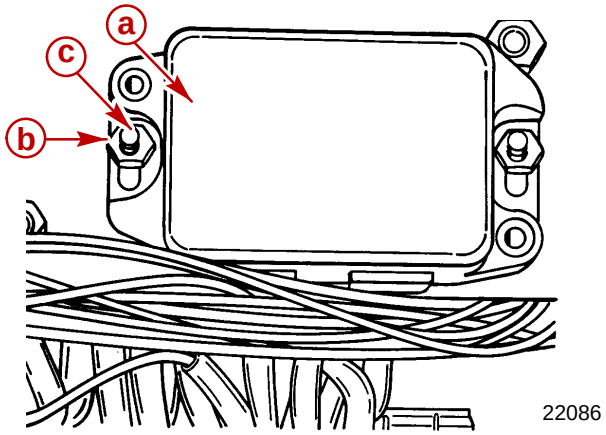
Diode Module Replacement

1. Remove control box cover.



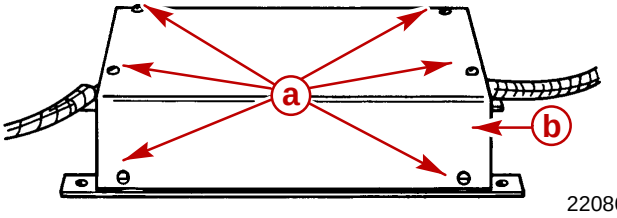
a - Screws
b - Cover

2. Disconnect leads from terminal block.
3. Replace diode module.



a - Diode Module
b - Nut
c - Screw

4. Reconnect numbered leads to respective terminals.
5. Install control box cover.



a - Screws
b - Cover

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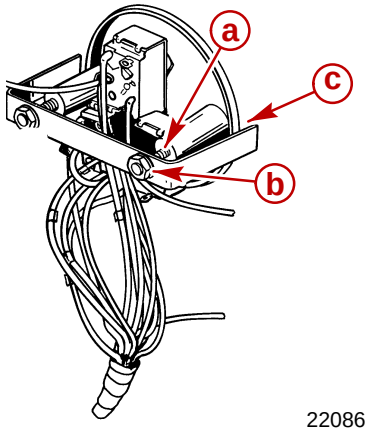
Trim Control Panel Switch(es) Replacement

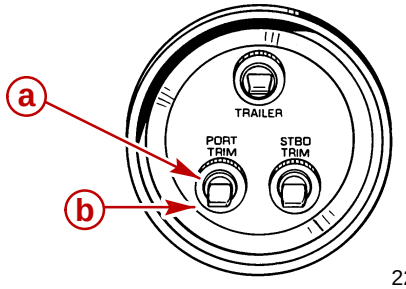
1. Remove trim control panel from dash.
2. Cut leads (from switch to be replaced) as close to switch terminals as possible.



22086

a - No. 10-24 Studs
b - Flat Washers and Nuts
c - U-Bracket

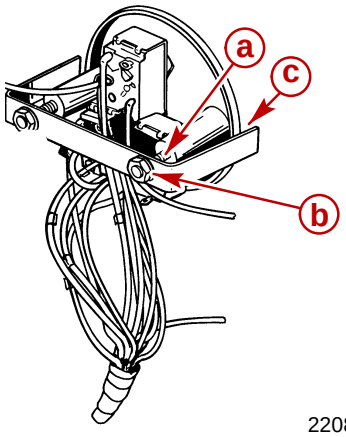
3. Remove bezel nut and replace switch.



22086

a - Bezel Nut
b - Switch

4. With new switch properly positioned in control panel, loop leads through their respective terminal eyelets. (Refer to Wiring Diagram)
5. Using 60-40 tin-lead alloy rosin core solder, solder leads to terminals.
6. Secure trim control panel to dash.



22086

a - No. 10-24 Studs
b - Flat Washers and Nuts
c - U-Bracket

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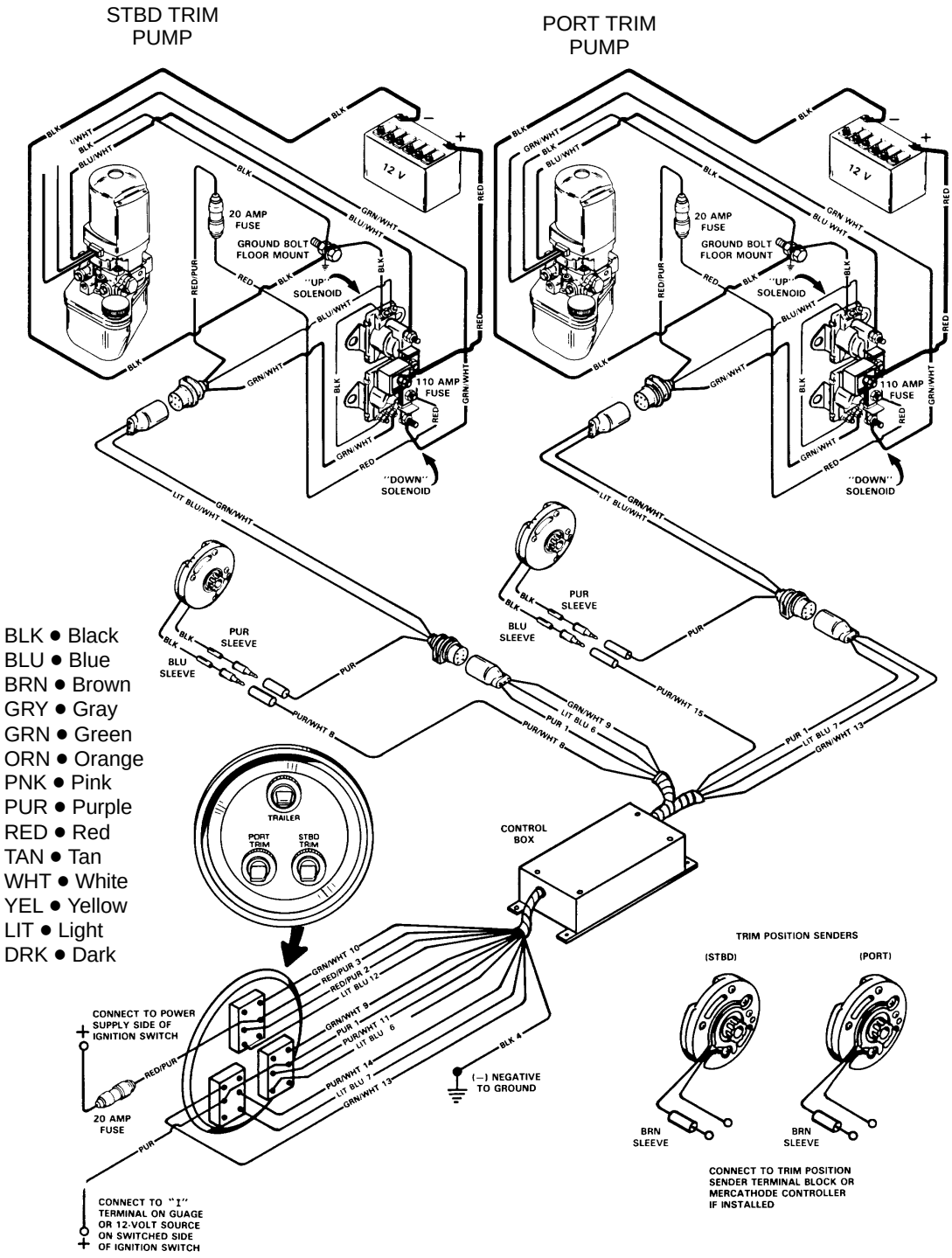
Wiring Diagrams

Dual Trim Harnesses



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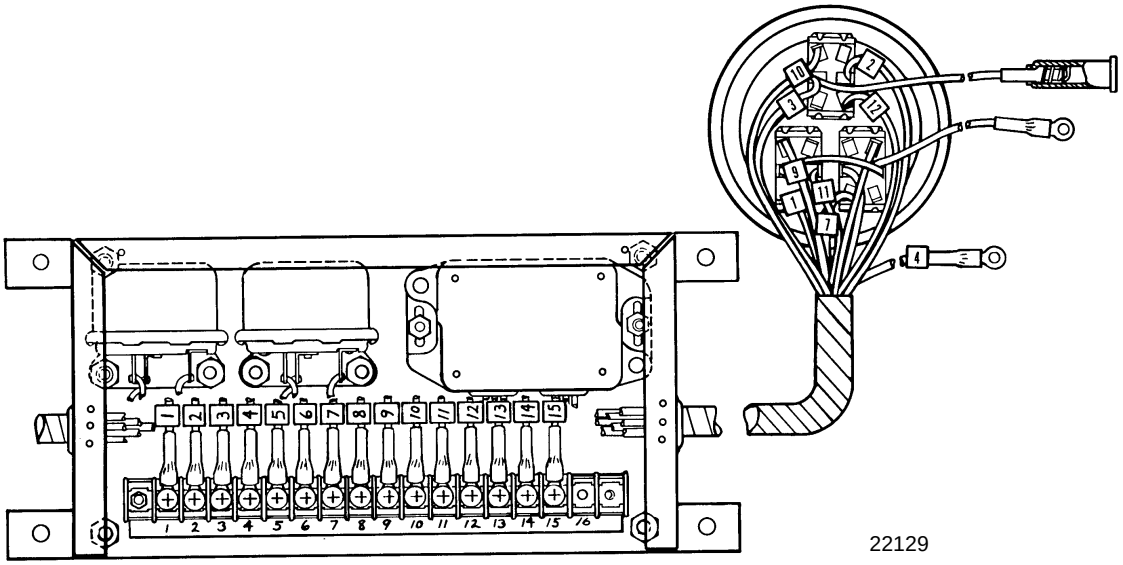
Electrical Box Wiring



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POWER TRIM

Section 5D - Auto Trim II

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Auto Trim II System

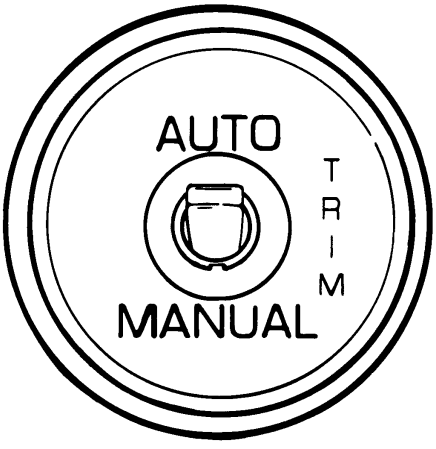
Description

The Auto Trim System consists of the following major components:

- Auto Trim Pump - same pump that is used on the standard Power Trim models.
- Control Module - a solid-state electronic device that senses engine RPM and regulates the time at which the drive unit trims IN and OUT when Operating in the “AUTO” mode. Module is protected by a 20-amp fuse.
- Mode Switch - allows the operator to select either “AUTO” or “MANUAL” trim operation from the dash.
- Manual Trim Control - will only function with mode switch in the “MANUAL” mode and ignition switch in the “RUN” position. Allows the operator to raise and lower the drive unit for trailering, beaching, launching and shallow water operation. Also, allows the operator to manually adjust the drive unit trim angle while underway in situations where automatic trimming is not desired (rough seas, etc.).
- Trim Limit Switch - Establishes the maximum trim OUT limit in both the “MANUAL” and “AUTO” mode. Prevents drive unit from moving out of the gimbal ring support flanges, which could cause possible damage to sterndrive if it were to occur at higher engine speeds.

Auto Trim II Operation

The Auto Trim system is designed to allow either automatic or manual trimming of the boat while underway - in addition to allowing drive unit to be raised for trailering, beaching, launching or shallow water operation. A 2-position switch on dashboard allows the operator to select the mode desired.



22217

Auto Mode Operation

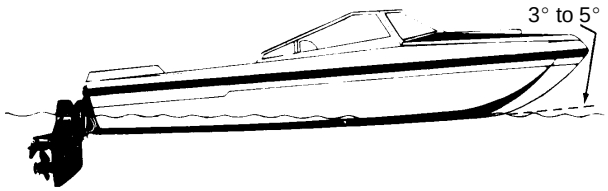
⚠ WARNING

Drive unit will automatically lower from the raised position when the ignition switch is turned to the "RUN" position and mode switch is placed in the "AUTO" mode. BE SURE THAT NO ONE IS IN THE AREA OF THE DRIVE UNIT.

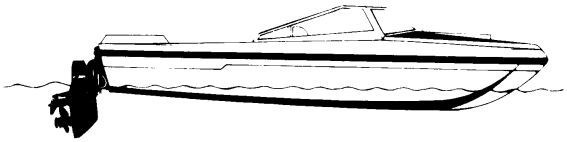
With mode switch in the "AUTO" mode, the drive unit will move automatically to properly trim boat while underway. This allows boat operator to keep both hands on the steering wheel and to direct operator's full attention to drive the boat.

- At engine speeds below 3100 RPM, the drive unit will remain in the full IN position. This will force the bow of the boat down and help it get up on plane quickly.
- Once engine reaches 3100 RPM and after a 5-6 second delay (to ensure that boat is up on plane), the drive unit will automatically trim OUT to a preset position for maximum boat speed and efficiency. Trim OUT position can be adjusted to fine tune the trim angle for each individual boat.
- Upon deceleration, the drive unit will trim IN when engine reaches 2600 RPM. Most boats will still be up on plane at this point. After drive reaches full IN position, the trim pump motor will continue to run for approximately 5 seconds.

NOTE: *The "AUTO" mode also can be used to lower the drive unit from the fully raised (trailering) position. By placing ignition switch in "RUN" position and mode switch in "AUTO" mode, the drive unit will automatically lower to the full IN position. Be sure that no one is in the area of the drive unit.*



Boat Running Above Planing Speed



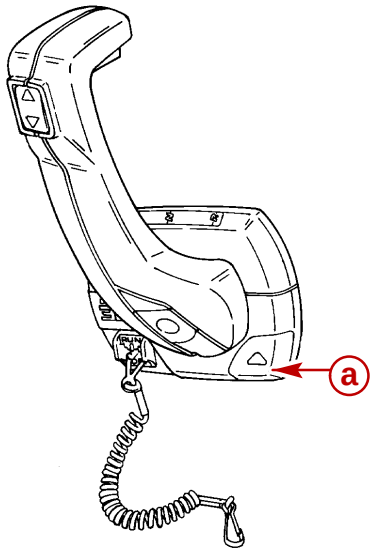
Boat Running Below Planing Speed

“Manual” Mode Operation

Placing the mode switch in the “MANUAL” position will deactivate the “AUTO” system and allow the operator to adjust drive unit position, using the manual trim control. Typical controls are shown following. Manual trimming may be desirable to fine tune the trim angle for a particular water condition or boat load, or in situations where greater control over the trim operation is needed.

Manual trim control also must be used to raise the drive unit for trailering, beaching, launching and shallow water operation. Ignition switch must be in the “RUN” position for manual trim control to function.

1. **RAISING DRIVE UNIT TO TRAILER POSITION -** Press until drive unit reaches desired height or end of upward travel.



Quicksilver Commander 3000 Series Control

a - Trailer Button

NOTE: *Some Power Trim pump motors are protected from overheating by an internal circuit breaker. If trailering switch(es) are held depressed after drive unit reaches end of upward travel, internal circuit breaker will open and pump will stop. If this should happen, release switch(es) and allow motor to cool for approximately 2 minutes. Once motor is cool, circuit breaker will reset automatically, and trim operation may be resumed.*

⚠ CAUTION
DO NOT run engine above idle RPM with unit raised for shallow water operation, as drive unit is out beyond gimbal ring support flanges and has no side support. USE EXTREME CAUTION WHEN OPERATING BOAT WITH DRIVE UNIT RAISED.

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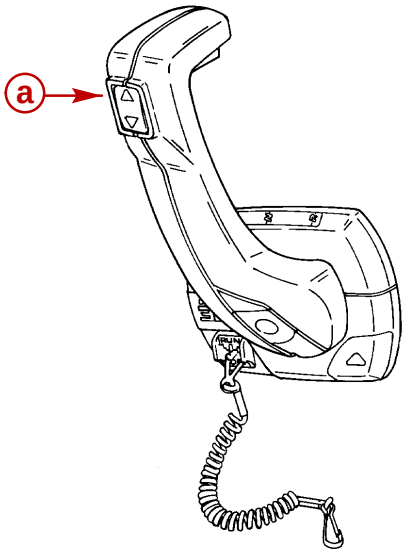
2. **TRIMMING DRIVE UNIT OUT (BOW UP)** - Press switch until drive unit moves to properly trim boat or trim limit switch stops outward travel.



22174

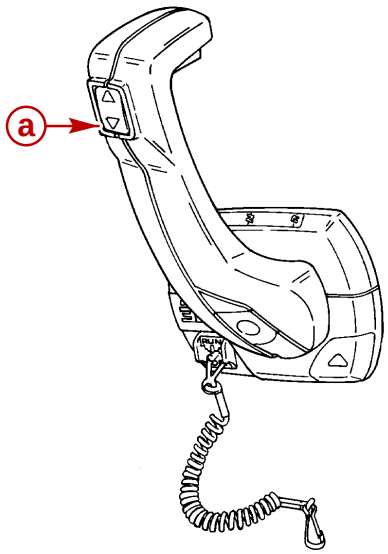
Quicksilver Commander 3000 Series Control

a - UP/OUT Button - Press

⚠ CAUTION

NEVER trim the drive unit OUT using the "Trailer" switch(es) while boat is underway. Severe damage to drive unit may result if the unit is raised beyond the gimbal ring support flanges at engine speeds above idle RPM.

3. **TRIMMING DRIVE UNIT IN (BOW DOWN) -** Press switch until drive unit moves to properly trim boat or until drive unit reaches end of downward travel.



70023

Quicksilver Commander 3000 Series Control

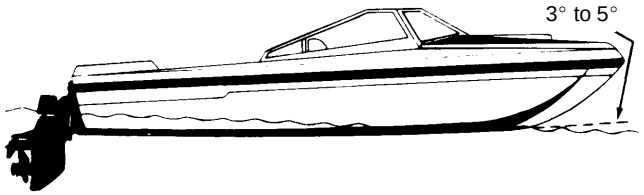
a - IN Button - Press

Electrical System Overload Protection

The Auto Trim electrical system is protected from overload by a 110-amp fuse, and a 20-amp in-line fuse at control module positive (+) battery lead and a 20-amp in-line fuse at ignition switch (if Quicksilver ignition switch is used). If boat is equipped with 3-Button Control Panel, a 20-amp in-line fuse also is located at panel. If Auto Trim electrical system becomes inoperative, check for a blown fuse. If fuse has blown, the cause for overload MUST BE found and corrected BEFORE replacing fuse.

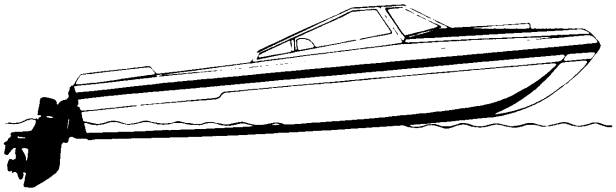
Auto Trim Limit Adjustment

In most cases, best all-around performance is obtained with drive unit adjusted so that front of hull will be slightly out of water when boat is on plane.



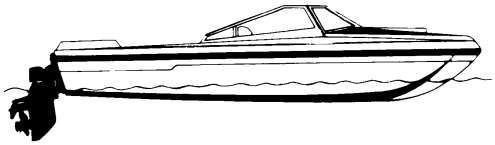
Boat Properly Trimmed

Adjusting the drive unit OUT from this position will tend to raise the bow of the boat, thus further reducing the wetted surface of the hull and, in some cases, increasing boat speed. However, if trimmed out excessively, bouncing, porpoising, propeller ventilation and possible difficult steering control could result.



Bow Too High - Move Drive Unit IN

Adjusting the drive unit IN from normal position will force the bow of the boat down, thus increasing the wetted surface of the hull and, in some cases, improving boat ride in rough water (at partial throttle). However, this will reduce boat speed.



Bow Too Low - Move Drive Unit OUT

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Adjusting Drive Unit Trim Angle

⚠ WARNING

When adjusting trim limit, following, use extreme care that engine is not accidentally started and keep clear of area near propeller. Also, use care to prevent placing hands in an area where they could be injured by drive unit movement.

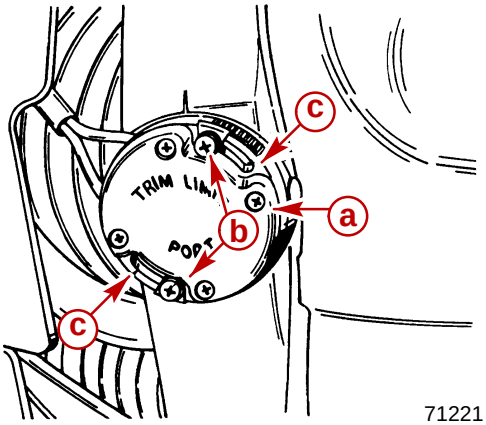
⚠ CAUTION

Trim limit switch MUST BE adjusted exactly as stated following. If switch is adjusted incorrectly, drive unit may move out beyond the gimbal ring support flanges (when making test run following), and severe damage to sterndrive unit may result.

If more trim OUT capability is desired, perform the following.

(DRY DOCK PROCEDURE)

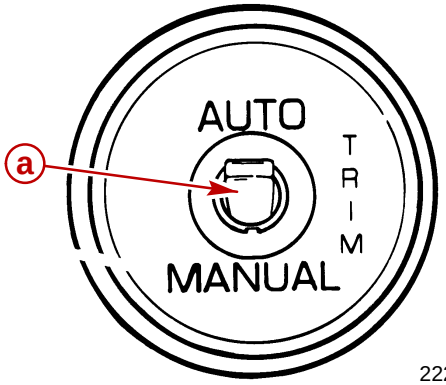
1. Place drive unit in the full IN/DOWN position.
2. Turn trim limit switch clockwise to end of slots.



71221

a - Trim Limit Switch
b - Retaining Screws - Loosen
c - Adjusting Slots

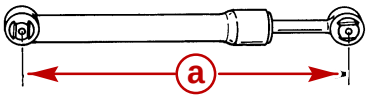
3. Place Auto Trim mode switch in the “MANUAL” mode; turn ignition key to the “RUN” position.



22217

a - Mode Switch - Place in “MANUAL” Mode

4. With the assistance of another person actuate manual trim control switch used to trim drive unit OUT (DO NOT use “Trailer” switch) and turn trim limit switch SLOWLY counterclockwise until trim cylinders extend to dimension shown. Retighten trim limit switch retaining screws.



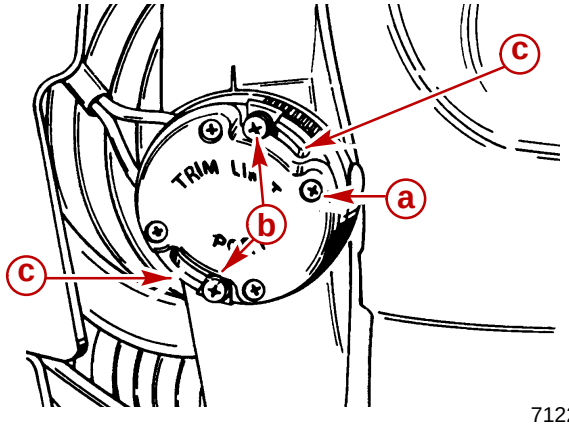
50464

a - Trim Limit Dimension 21-3/4 in. (552 mm)

5. Turn ignition key “OFF.”

(ON-WATER PROCEDURE)

1. Run boat along a relatively smooth stretch of water and trim boat with manual trim control until optimum boat performance is achieved.
2. After finding trim angle that provides best performance, stop engine (without changing drive unit trim angle). Accurately measure distance between trim cylinder end cap and pivot end.
3. Place drive unit in the full IN position. Loosen trim limit switch retaining screws and turn switch clockwise to end of slots.



71221

a - Trim Limit Switch
b - Trim Limit Switch Retaining Screws
c - Adjusting Slots

4. Leaving Auto trim mode switch in the “MANUAL” mode, turn ignition key to “RUN” position. With the assistance of another person, actuate manual trim control switch used to trim drive unit OUT and turn trim limit switch slowly counterclockwise until trim cylinders extend to dimension recorded in STEP 7. Tighten switch retaining screws securely.
5. Run boat with Auto Trim mode switch in “AUTO” position at several speeds, through turns under various water and load conditions, if boat does not perform to satisfaction, repeat adjusting procedure.

⚠ WARNING

Difficulties in handling and operational control may result if drive unit is adjusted OUT too far. If difficulties are encountered, drive unit trim angle MUST BE moved IN the amount necessary to eliminate the problem and avoid a possible safety hazard.

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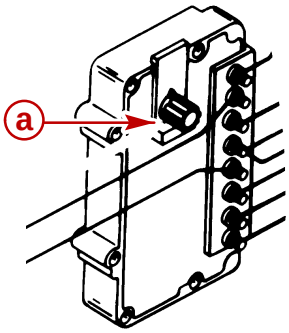
Control Module Adjustment

1. Turn adjustment knob on control module full counterclockwise.
2. Rotate knob clockwise four clicks (notches).
3. With mode switch in “AUTO” position and the drive unit trimmed full IN, accelerate boat slowly while watching trim gauge.
4. If boat is on plane well before drive unit begins to trim out (this may happen with lighter, faster boats), rotate adjustment knob counterclockwise one click and accelerate boat slowly.

Continue procedure until boat is on plane approximately five or six seconds before trim out occurs.

5. If boat is not on plane before drive unit begins to trim out (this may happen with slower, heavier boats), rotate adjustment knob clockwise one click and accelerate boat slowly.

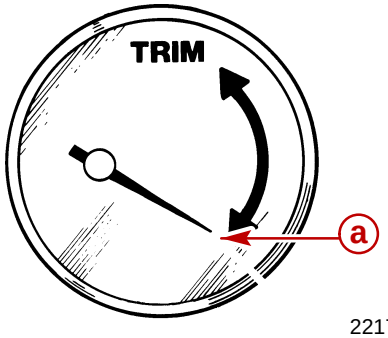


22178

a - Adjustment Knob

Trim Position Indicator Adjustment

With ignition key in the “RUN” position, check Auto Trim indicator to make sure that needle points to bottom of the scale when drive unit is fully “IN.” If needle is not at bottom of scale, perform steps following.



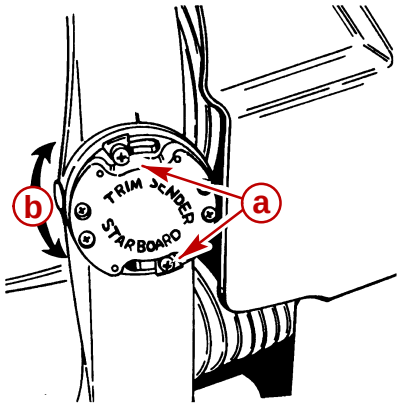
22175

a - Needle at Bottom of Scale - Drive Unit in Fully IN Position

⚠ WARNING

While performing this adjustment, use extreme care that engine is not accidentally started; keep clear of the area near propeller.

1. Turn ignition key to “RUN” position.
2. Loosen trim position sender retaining screws.
3. Rotate sender, as required, to position indicator at bottom of scale.
4. Tighten retaining screws securely.
5. Recheck instrument reading and turn ignition key to “OFF” position.

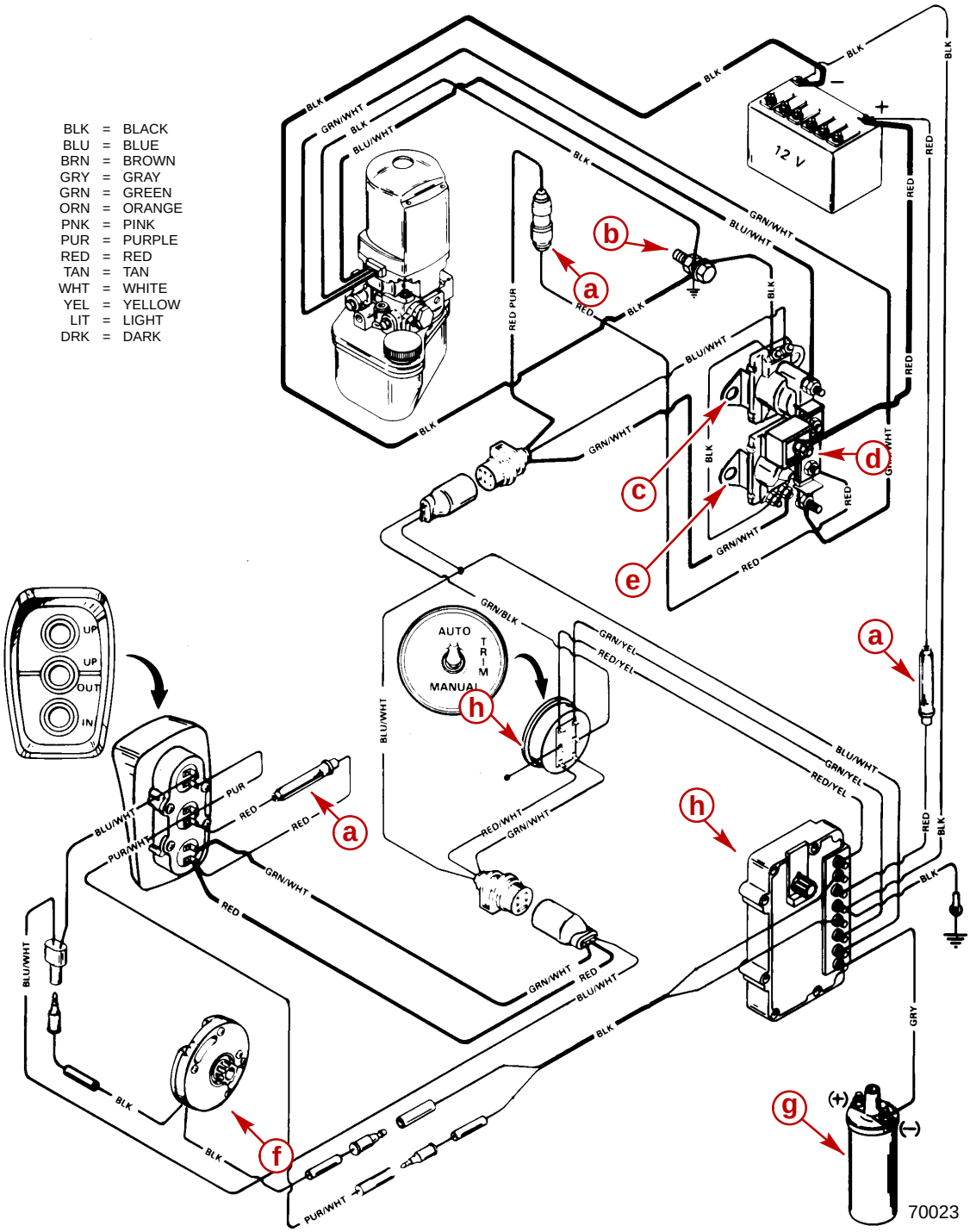


71220

a - Retaining Screws
b - Turn to Adjust

Wiring Diagram

BLK = BLACK
BLU = BLUE
BRN = BROWN
GRY = GRAY
GRN = GREEN
ORN = ORANGE
PNK = PINK
PUR = PURPLE
RED = RED
TAN = TAN
WHT = WHITE
YEL = YELLOW
LIT = LIGHT
DRK = DARK



a - 20 Amp Fuse
b - Ground Bolt (Floor Mount)
c - UP Solenoid
d - 110 Amp Fuse
e - DOWN Solenoid
f - Trim Limit Switch
g - Ignition Coil
h - Control Module
i - Auto/Manual Switch
j - Trim Switches (Various Styles)

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STEERING SYSTEMS

Section 6A - Power Steering

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6A

Specifications

Special Tools

DESCRIPTION	PART NO.
Power Steering Test Gauge	91-38053A4
Power Steering Pump Pulley Installer	91-93656A1

KENT-MOORE SPECIAL TOOLS	
Can be ordered from: Kent-Moore Tools, Inc. 29784 Little Mack Roseville, MI 48066 Phone: (313) 774-9500	
Power Steering Pump Pulley Remover	Kent-Moore Part No. J-25034

Lubricants/Adhesives/Sealers

DESCRIPTION	PART NO.
2-4-C Marine Lubricant with Teflon	92-825407A12
Special Lubricant 101	92-13872A1
Loctite No. 8831	92-826089-1

Description

The Power Steering system utilizes an engine-driven, vane-type hydraulic pump that supplies fluid flow and pressure by means of hoses to a control valve that, in turn, controls fluid flow and pressure to-and-from a booster cylinder. Three modes make up the basic function of the Power Steering system: 1) neutral mode, 2) left turn mode, and 3) right turn mode. The control valve, which is activated by the steering cable, controls the steering system modes.

NOTE: *The following Power Steering unit installations are viewed from inside boat, looking at transom.*

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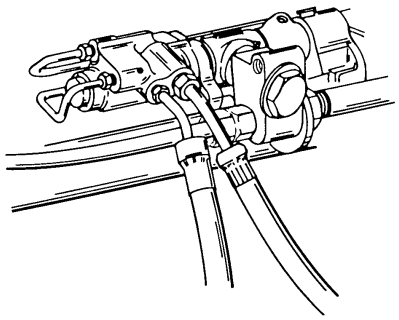
Earlier Style Control Valve

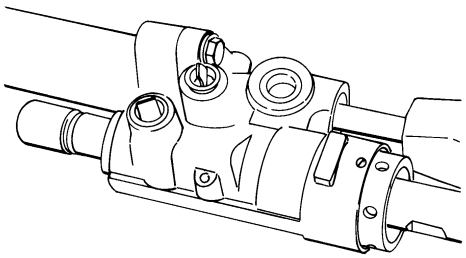
Most illustrations in this section show an earlier style power steering control valve. This valve has various components that can be replaced and or serviced.



50912

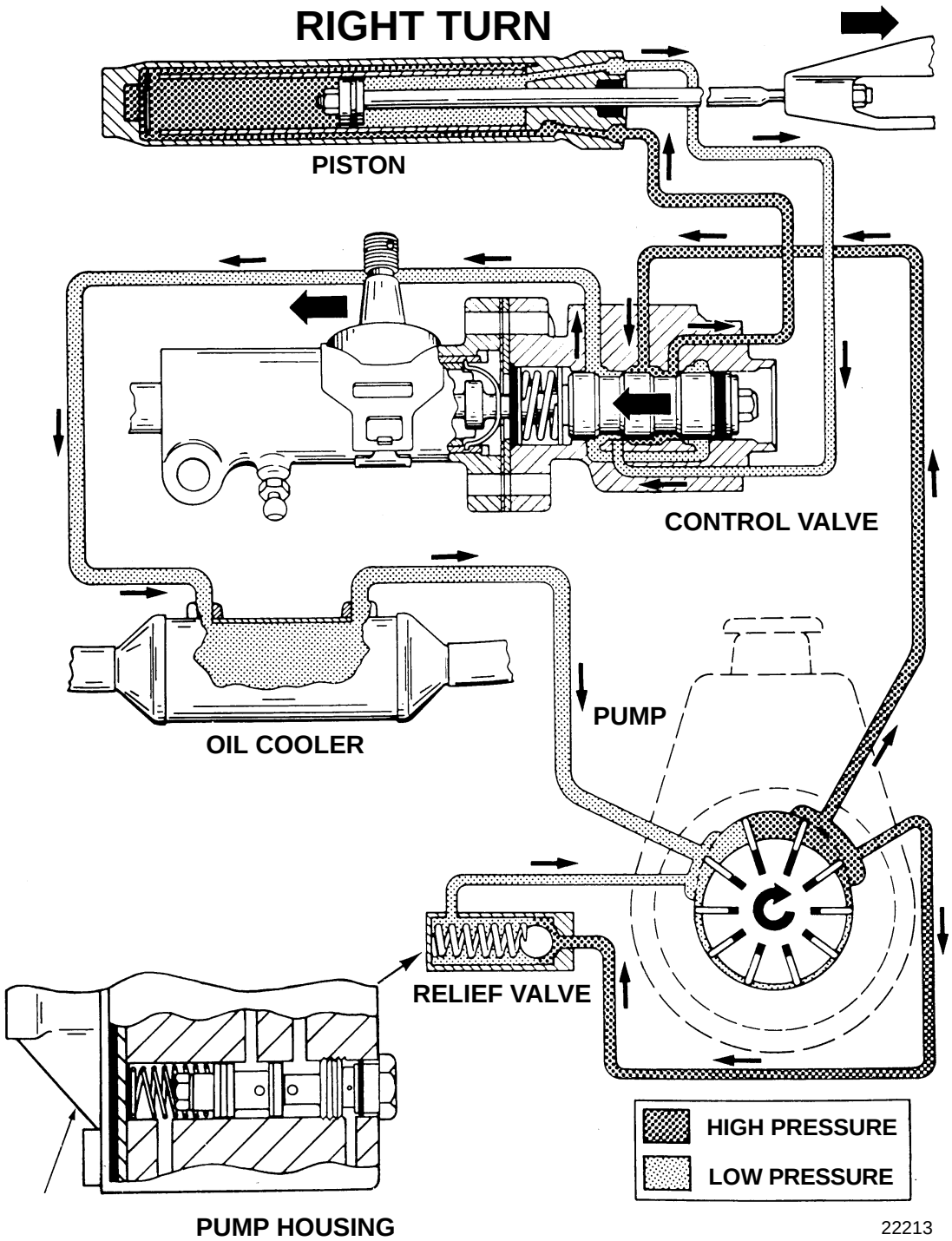
Later Style Control Valve

The later style control valve is not serviceable and must be replaced as a complete assembly.



73898

Earlier Model Power Steering System



(VIEWING FROM INSIDE OF BOAT LOOKING AT TRANSOM)

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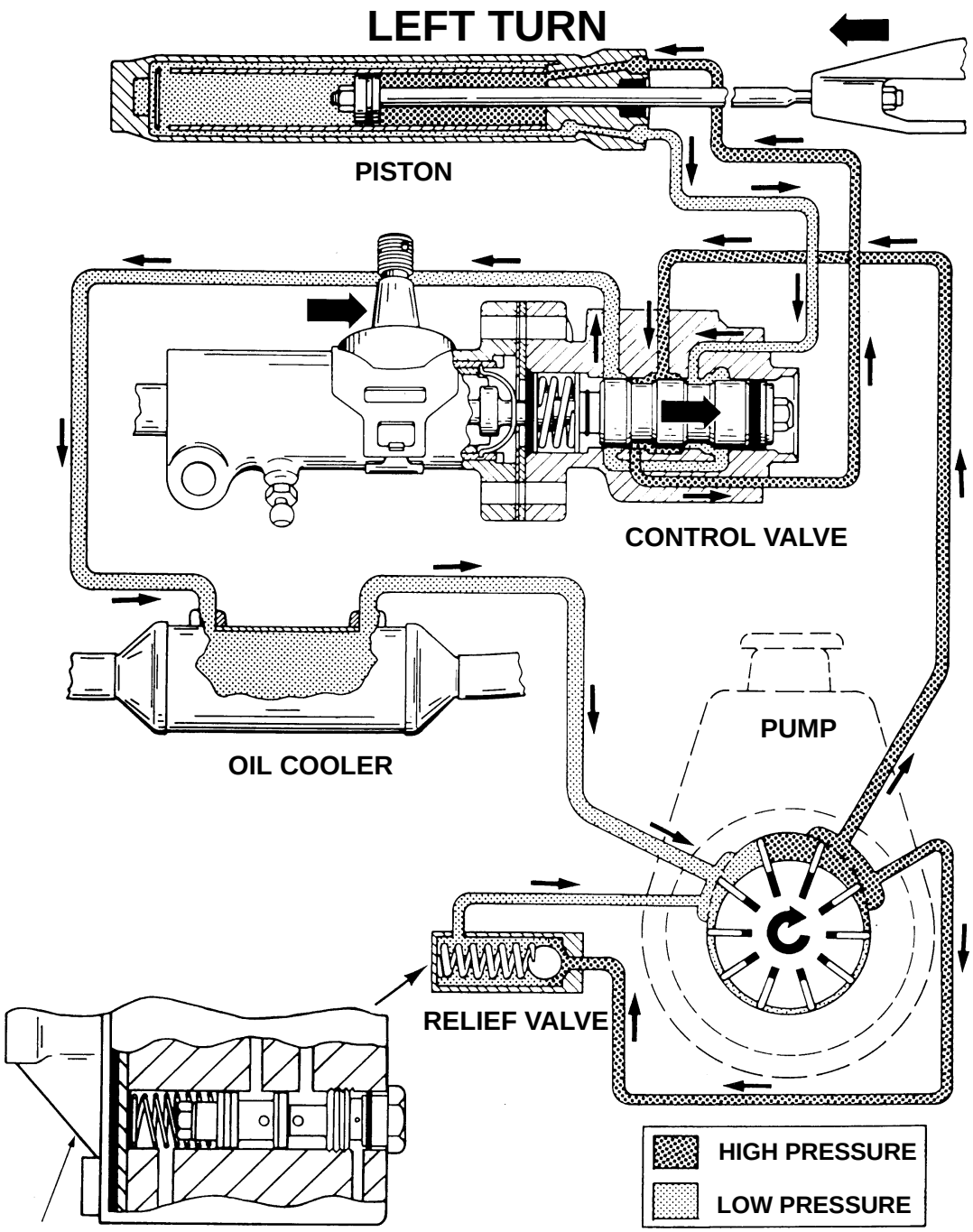
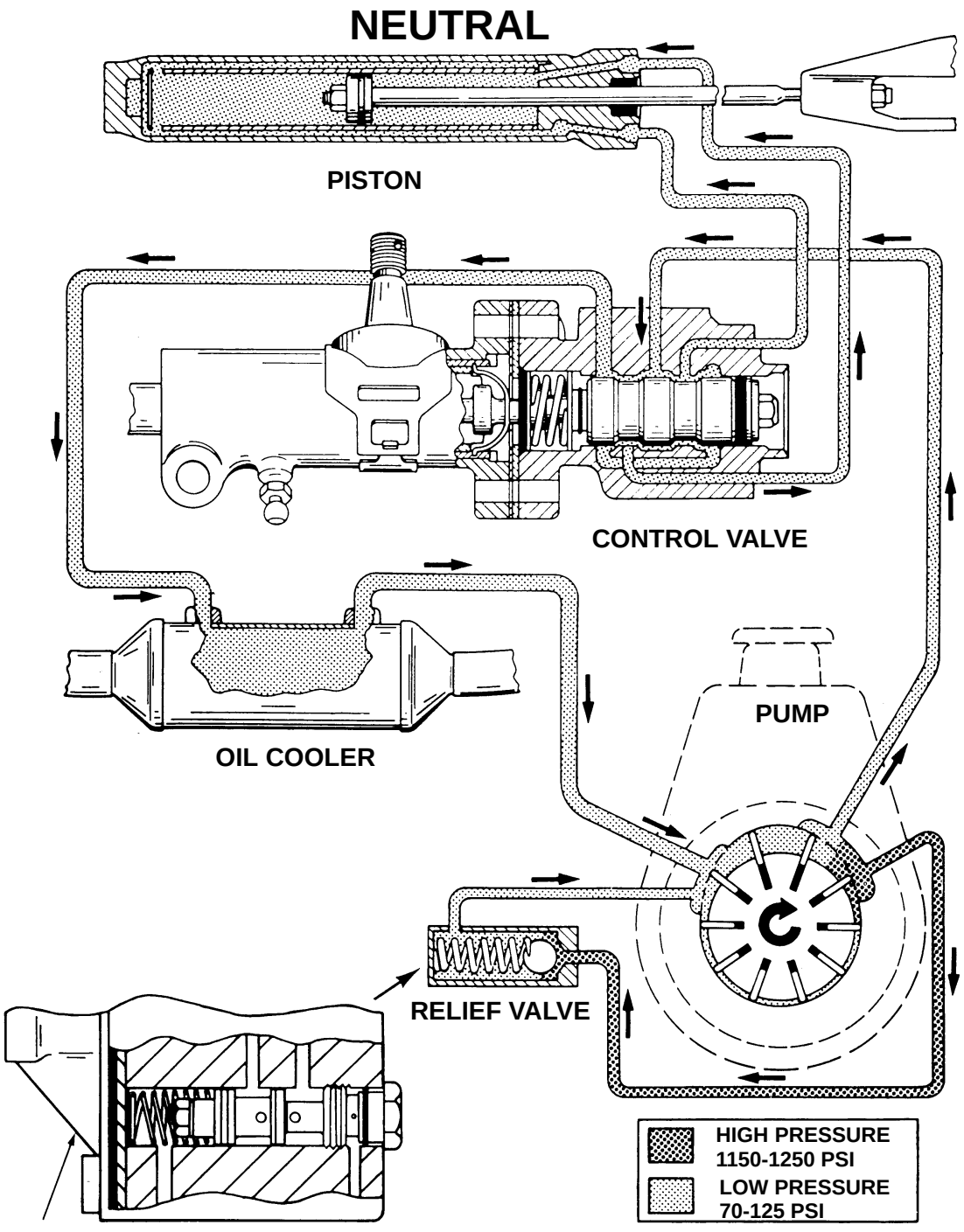
Earlier Model Power Steering System



22215

(VIEWING FROM INSIDE OF BOAT LOOKING AT TRANSOM)

Earlier Model Power Steering System



(VIEWING FROM INSIDE OF BOAT LOOKING AT TRANSOM)

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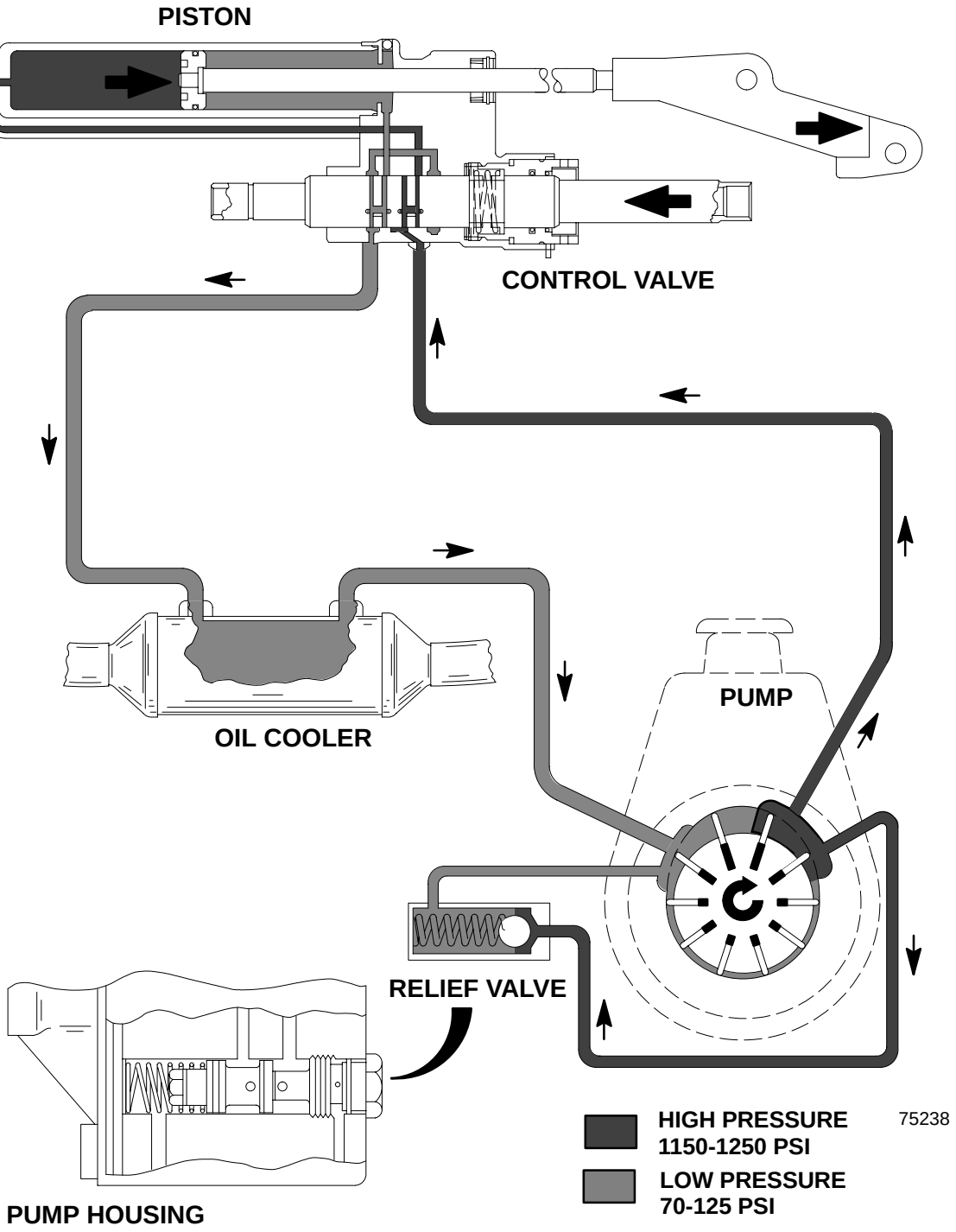
Later Model Power Steering System

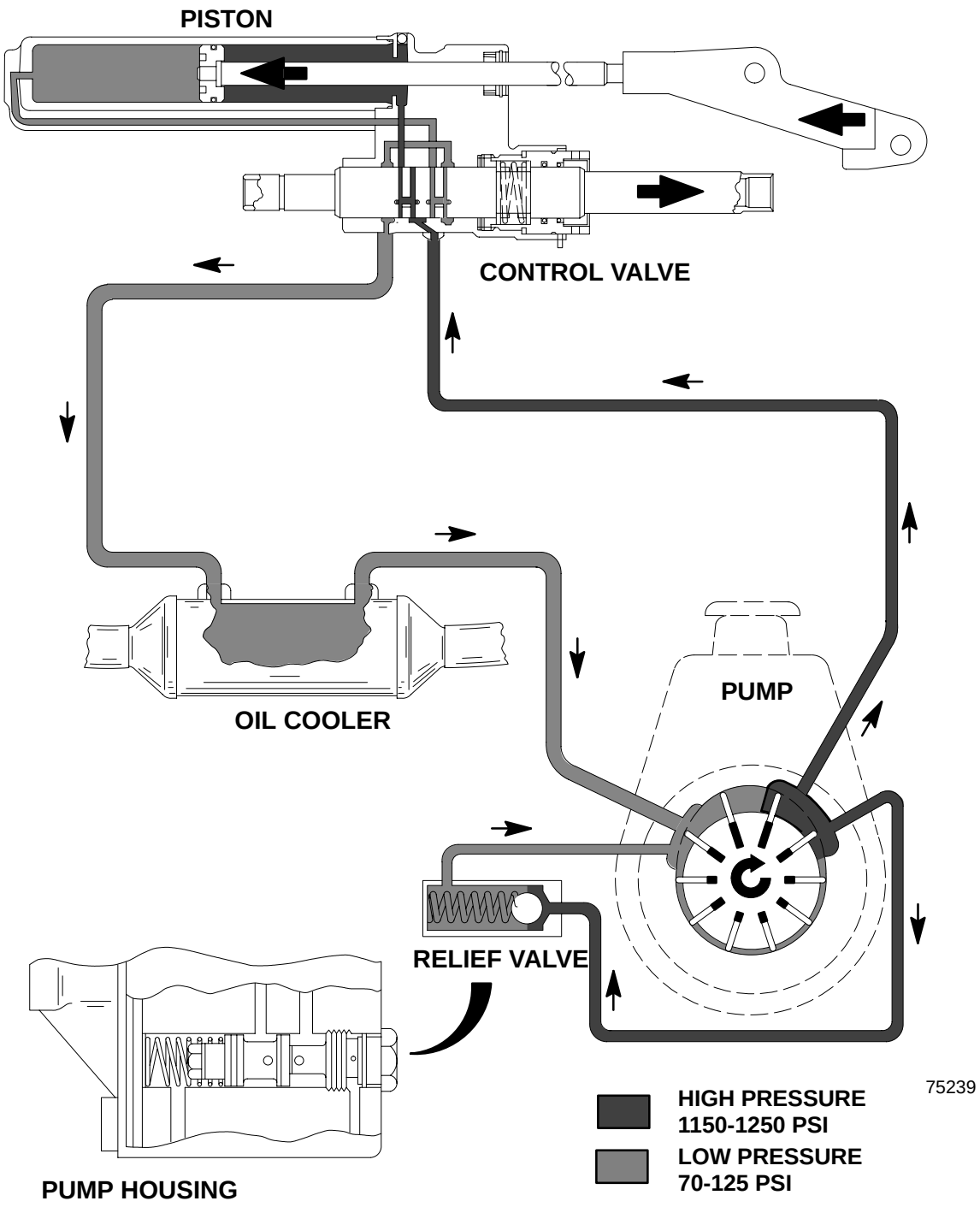
RIGHT TURN



(VIEWING FROM INSIDE OF BOAT LOOKING AT TRANSOM)

Later Model Power Steering System

LEFT TURN



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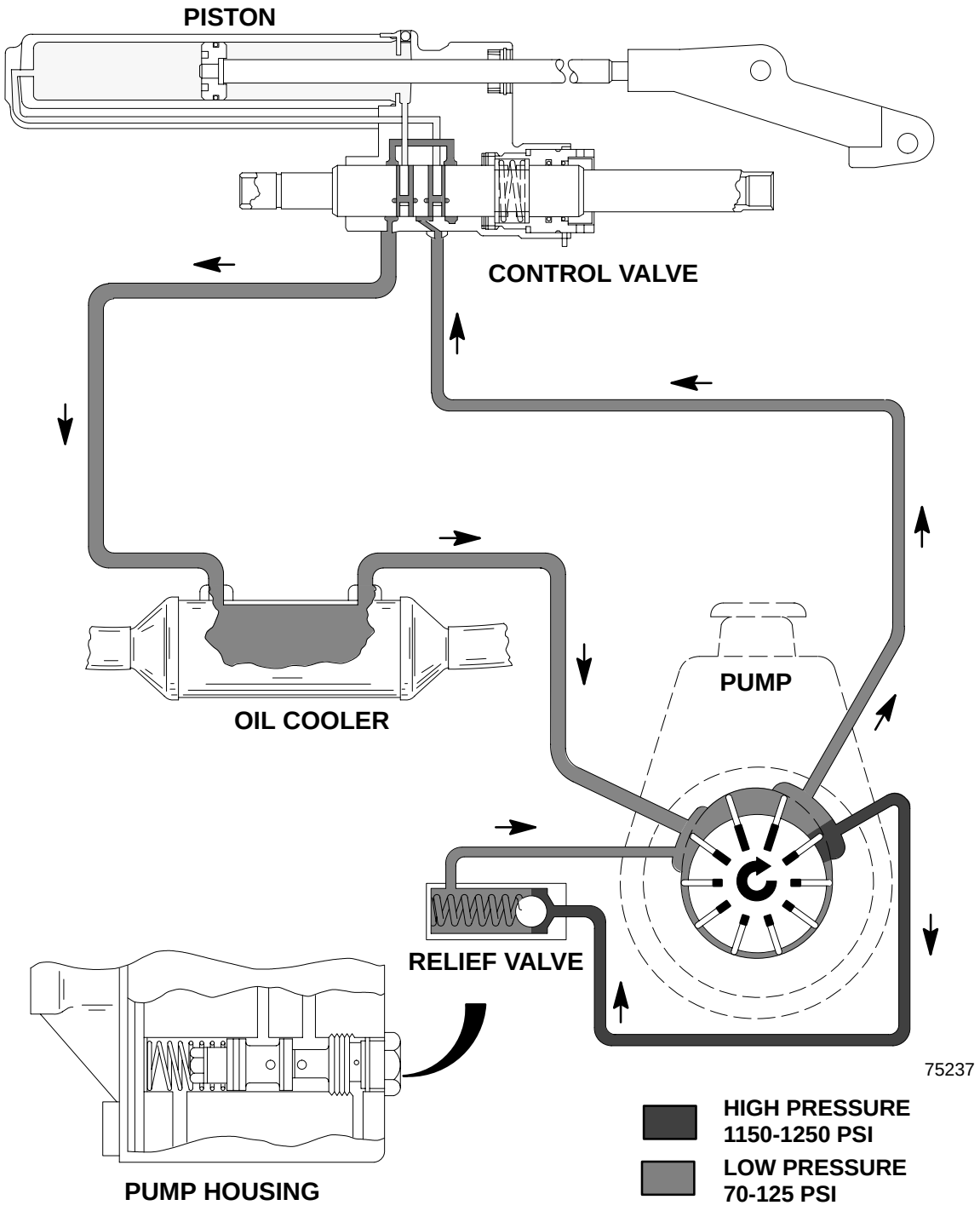
Later Model Power Steering System

NEUTRAL



(VIEWING FROM INSIDE OF BOAT LOOKING AT TRANSOM)

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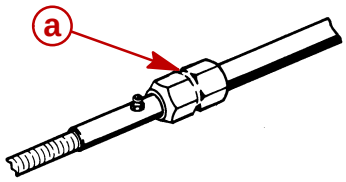
Steering Helm and Cable

Transom assembly is shipped with the steering cable guide tube preset for cables with end dimensions that comply with ABYC standards as outlined in the NMMA certification handbook. The steering cable coupler nut must also have a means of locking it to the guide tube, as specified in ABYC requirements.

⚠ WARNING

Failure to use a steering cable locking device could cause loss of steering, which could cause damage to the boat and/or injury.

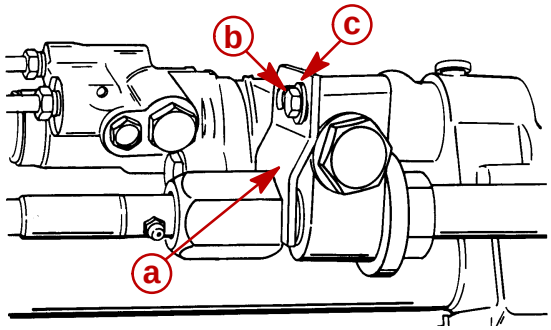
All current production Quicksilver Ride Guide steering cables have a self-locking coupler nut and do not require an external locking device. (Other cable manufacturers also make cables with self-locking coupler nut.)



22060

a - Quicksilver Ride Guide Steering Cable Self-Locking Coupler Nut (Identified by Groove)

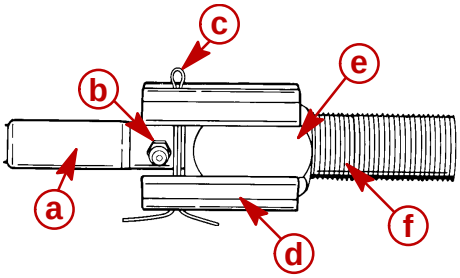
IMPORTANT: If using a steering cable that does not have a self-locking coupler nut, an external locking device must be used.



50629

Locking Plate

a - Locking Plate P/N 92766
b - Screw P/N 10-41209 - (see “Torque Specifications”)
c - Washer P/N 12-35462



Locking Sleeve

a - Steering Cable
b - Grease Fitting
c - Cotter Pin
d - Locking Sleeve (If Required - Must Be Ordered Separately)
e - Cable Coupler Nut
f - Cable Guide Tube

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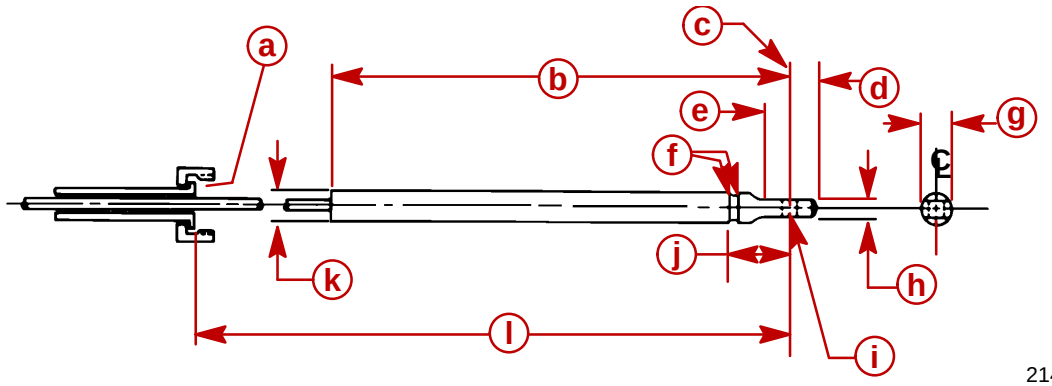
⚠ CAUTION

POWER STEERING EQUIPPED UNITS ONLY - If cables with improper dimensions are installed, severe damage to transom assembly and/or steering system may result. DO NOT attempt to adjust cable guide tube on power steering unit, as guide tube and locknut have been torqued (with Loctite) at the factory, and an attempt to loosen nut or sleeve may result in damage to tube.

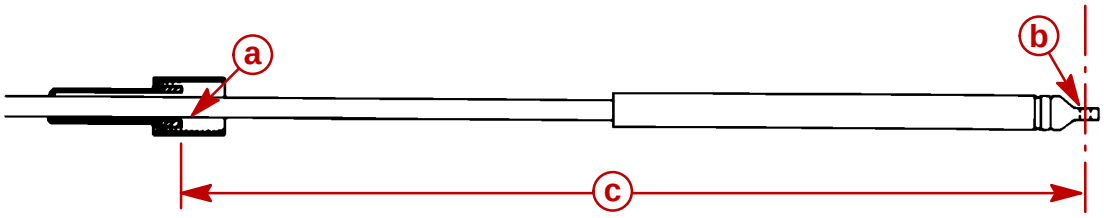
1. Steering cable must be the correct length, particularly when installed in larger boats.
2. Avoid sharp bends, kinks or loops in cable.
3. **Power Steering Models:** Fully extended steering cable end dimension must be correct.

Steering Cable Specifications



21435

a - Coupler Nut - 7/8 - 14 UNF - 2B Thread
b - 11-3/4 in. (298 mm) Min.
c - Interface Point
d - 1/2 in. (12.7 mm) Max.
e - .420 in. (10.668 mm) Min. Flat
f - .102 in. (0.508 mm) Min. Radius
g - 5/8 in. (15.875 mm) Max. Diameter End Fitting
h - 3/8 in. (9.525 mm)
i - .385 in. (9.779 mm) Diameter Thru Hole, Chamfered Each Side
j - 1-3/8 in. (34.925 mm) Max.
k - 5/8 in. (15.875 mm) Diameter Tube
l - Mid-Travel Position - 16-7/8 in. (428.6 mm). Total Travel To Be 8 in. (203.2 mm) Min., to 9 in. (228.6 mm) Max. Travel Each Side of Mid-Travel Position - 4 in. (101.6 mm) Min., 4-1/2 in. (114.3 mm) Max.



a - Steering Cable Mounting Flange
b - Center of Hole in Steering Cable End
c - 21-3/8 in. (543 mm) Maximum

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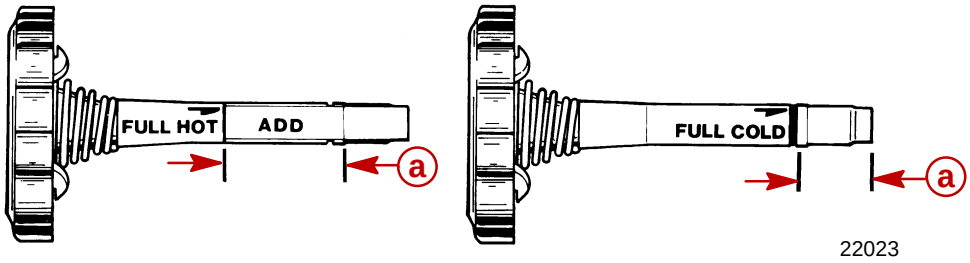
Filling and Air Bleeding Power Steering System

IMPORTANT: Power Steering system MUST BE filled exactly as explained, following, to be sure that all air is bled from the system. All air must be removed, or fluid in pump may foam during operation and be discharged from pump reservoir. Foamy fluid also may cause Power Steering system to become spongy, which may result in poor boat control.

1. Position drive unit straight back. Remove fill cap from power steering pump and check fluid level with dipstick.
2. Add Quicksilver Power Trim and Steering Fluid or Dexron II, as required, to bring fluid up to correct level.



Engine Warm from Operation **Engine Cold**

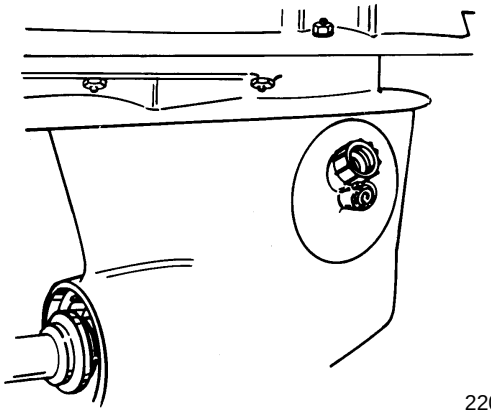
a - Recommended Fluid Level

3. (With engine not running), turn the steering wheel at a moderate rate, back-and-forth, to end of travel in each direction, pausing each time at end of travel for a few seconds to allow any air to bubble from pump reservoir. Do this a minimum of 5 complete cycles. Recheck fluid level and add if necessary.
4. Reinstall fill cap.

⚠ CAUTION

DO NOT operate engine without water being supplied to seawater pickup holes in gear housing. Overheating damage to engine may result.

5. Install flush test device and connect a hose between it and water tap.



NOTE: *If using a test tank or if boat is in the water, ensure sterndrive unit gear housing water intake holes are below water level.*

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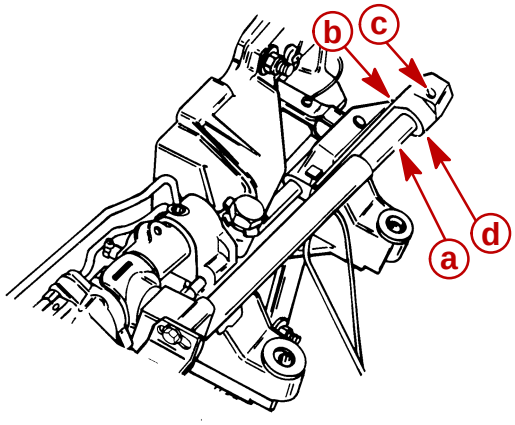
6. Partially open water tap (approximately 1/2 max.) and allow water to enter cooling system. DO NOT use full water tap pressure.
7. Start engine and run at idle. During this time, turn steering wheel back-and-forth to end of travel in each direction several times.
8. Position drive unit so that it is straight back and then stop engine. Remove fill cap from pump. Allow any foam in pump reservoir to disperse, then check fluid level and add fluid, if needed. DO NOT OVERFILL. Reinstall fill cap and tighten securely.
9. If fluid was foamy in previous step, repeat steps 7 and 8 until fluid does not foam and level remains constant.

Balancing Power Steering Control Valve

IMPORTANT: Control valve is balanced by the manufacturer and should not require further adjustment. However, if drive unit tends to creep in one direction or the other (with engine running, drive unit in neutral, and hands off the steering wheel), the control valve MUST BE balanced as explained following.

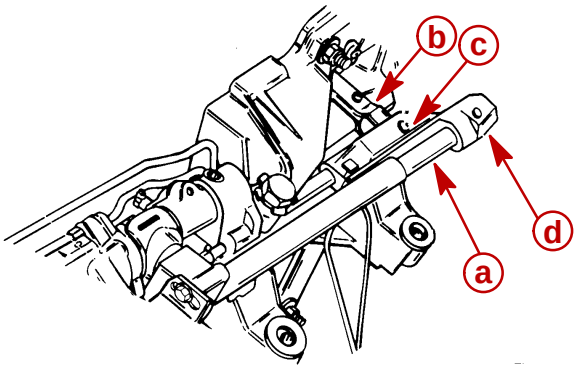
1. Ensure engine is off.
2. Disconnect steering cable from power steering control valve clevis.



22023

a - Steering Cable
b - Clevis
c - Pin
d - Cotter Pin

3. Disconnect power steering control valve clevis from drive unit steering lever.



22023

a - Clevis
b - Steering Lever
c - Pin
d - Cotter Pin (Hidden)

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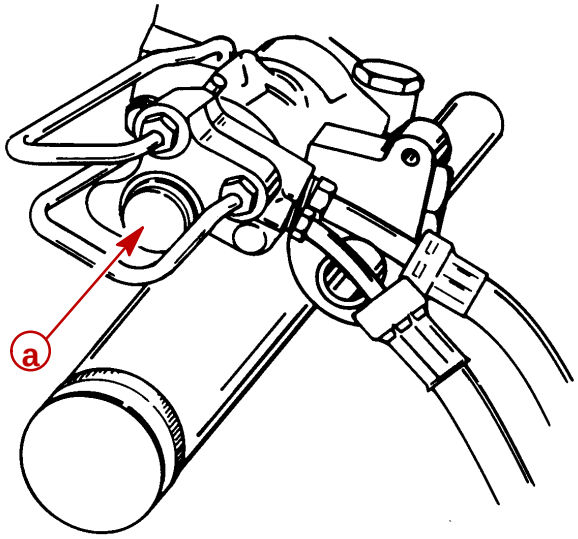
4. Remove dust cover.



22023

a - Dust Cover

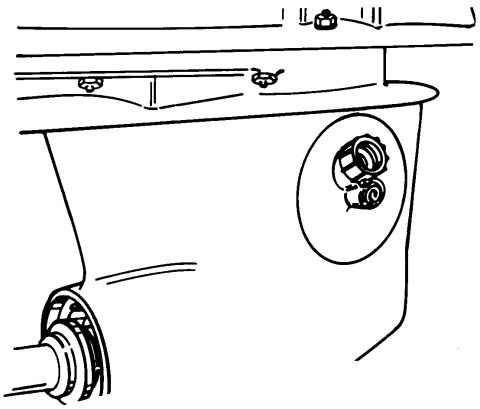
⚠ CAUTION

DO NOT operate engine without water being supplied to seawater pickup holes in gear housing. Water pump damage and overheating damage to engine may result.

⚠ WARNING

Remain clear of power steering clevis when starting engine. If control valve is not balanced, unexpected movement of clevis could cause injury.

5. Connect a flush test device to drive unit. Partially open water tap (approximately 1/2 max.) and allow water to enter cooling system. DO NOT use full water tap pressure.



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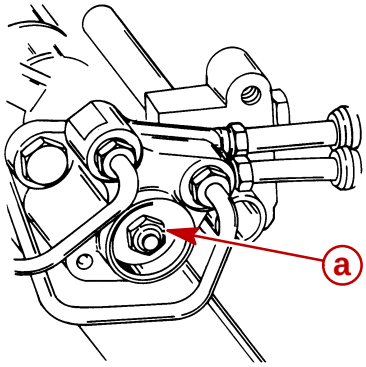
6. Start engine and adjust control valve by turning adjustment nut as follows:



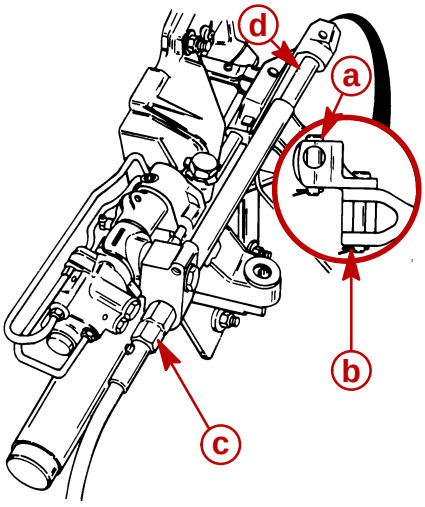
22023

a - Adjustment Nut

   a. **If power steering piston rod end clevis moves toward right (starboard),** turn nut clockwise until clevis just begins to move toward left (port), then turn nut counterclockwise until clevis just begins to move toward right (starboard). Turn nut clockwise to exactly 1/2 the rotation necessary to change direction of rod end clevis movement.

   b. **If power steering piston rod end clevis moves toward left (port),** turn nut counterclockwise until clevis just begins to move toward right (starboard), then turn nut clockwise until clevis just begins to move toward left (port). Turn nut counterclockwise to exactly 1/2 the rotation necessary to change direction of rod end clevis movement.

7. Turn off engine.
8. Apply a liberal amount of Special Lubricant 101 to end of steering cable and install cable end in clevis. Secure with pin and cotter pin.
9. Torque self-locking coupler nut to 35 lb. ft. (48 N·m).
10. Install and tighten locking plate on coupler nut. Secure with self-locking bolt and washer (if required).



50927

a - Clevis Pin
b - Cotter Pin
c - Self-Locking Coupler Nut
d - Steering Cable

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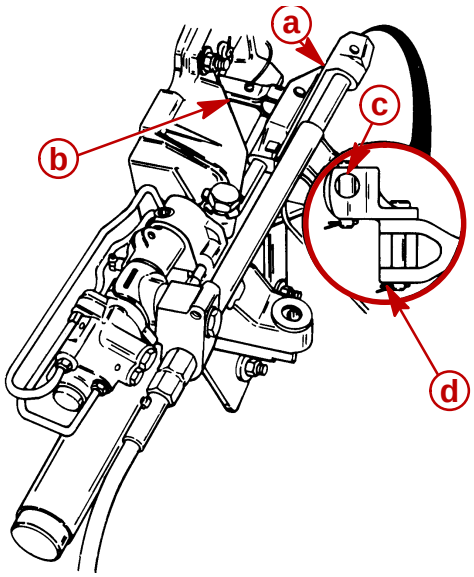
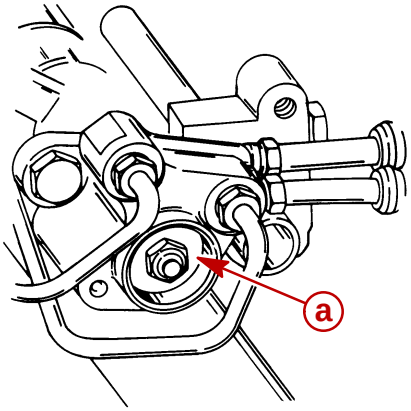
11. Reconnect power steering control valve piston rod end clevis to drive unit steering lever.



50927

a - Clevis
b - Steering Lever
c - Pin
d - Cotter Pin

12. Place 2-4-C Marine Lubricant with Teflon in adjustment nut cavity and reinstall dust cover.



22023

a - Adjustment Nut Cavity

13. Restart engine and observe drive unit. If drive unit still creeps in one direction or the other, an external tension may exist on steering cable. Ensure that nothing is attached to steering cable (pushing or pulling).

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Steering Cable Selection, Removal and Installation

Selection

Steering system has the steering cable guide tube set for cables with end dimensions which comply with the BIA Certification Handbook. Refer to “Steering Cable Specifications” listed previously in this section.

⚠ CAUTION

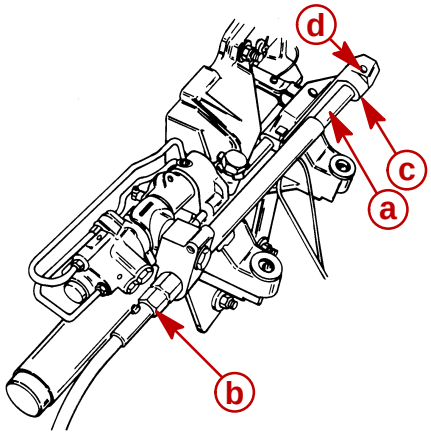
If cables with improper dimensions are installed, severe damage to transom assembly and/or steering system may result.

⚠ CAUTION

Steering cables MUST BE THE CORRECT LENGTH, particularly when installed in large boats. Sharp bends or too-short cables result in kinks; too-long cables require unnecessary bends and/or loops. Both place an extra stress on the cable. The proper cable is as short as possible, with the fewest bends and with radii as large as possible.

Removal

1. Remove steering cable.



50912

a - Steering Cable
b - Self-Locking Cable Coupler Nut
c - Cotter Pin
d - Clevis Pin

Installation

⚠ WARNING

Steering cable outer casing MUST BE free to move back-and-forth for steering to function properly. DO NOT fasten any wires, cables or other items to steering cable, as this may prevent it from moving.

1. Apply a liberal amount of Special Lubricant 101 to end of steering cable and install cable end in clevis. Secure with pin and cotter pin.
2. **Later model control valve:** Using a suitable wrench, hold the flat surfaces on the cable guide tube in the vertical position.
3. **Both models:** Torque coupler nut to 35 lb. ft. (48 N·m).
4. **Earlier model control valve:** Install and tighten locking plate on coupler nut. Secure with self locking bolt and washer.

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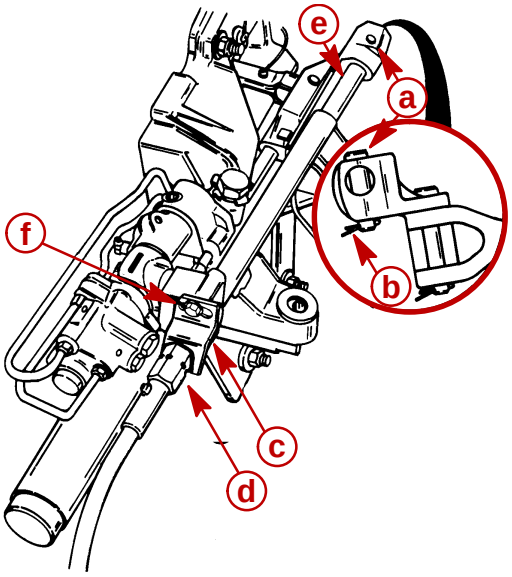
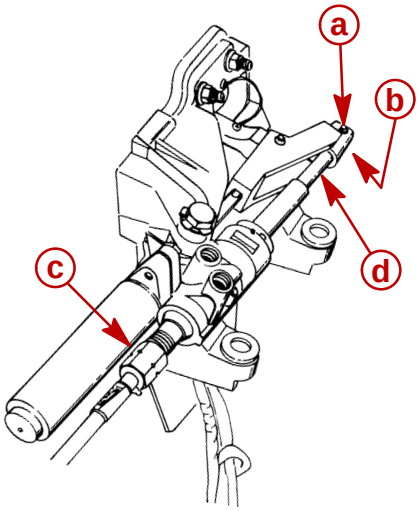
NOTE: *Later model control valves do not have a locking plate on the coupler nut*



50352

Earlier Model Control Valve

a - Clevis Pin
b - Cotter Pin
c - Locking Plate (If No Self Locking Coupler Nut)
d - Coupler Nut
e - Steering Cable
f - Bolt and Washer



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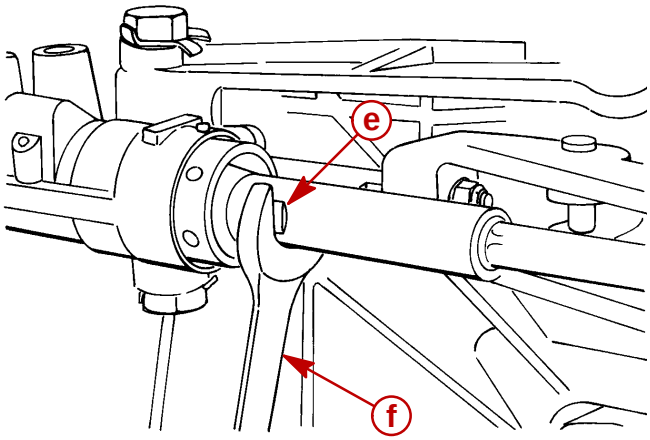

73901

Later Model Control Valve

a - Clevis Pin
b - Cotter Pin
c - Coupler Nut
d - Steering Cable
e - Flat (Hold Vertical)
f - Suitable Wrench

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Installation

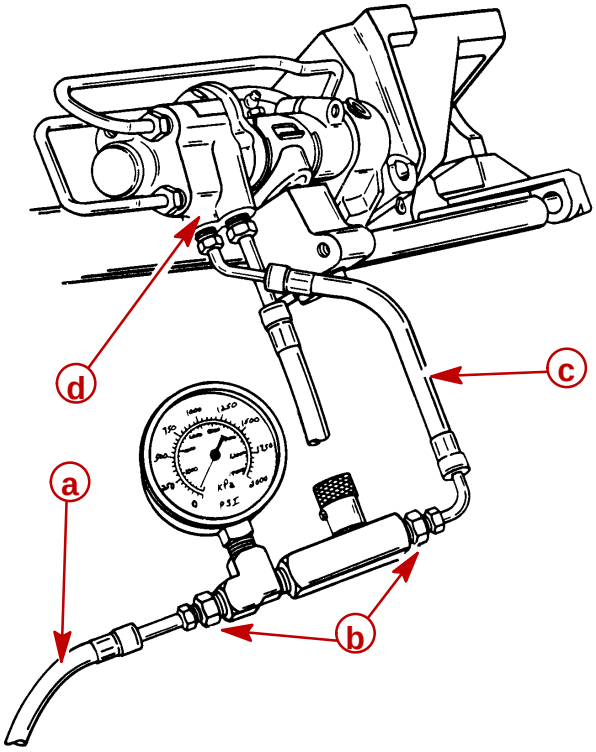
⚠ WARNING

Steering cable outer casing MUST BE free to move back-and-forth for steering to function properly. DO NOT fasten any wires, cables or other items to steering cable, as this may prevent it from moving.

1. Apply a liberal amount of Special Lubricant 101 to end of steering cable and install cable end in clevis. Secure with pin and cotter pin.
2. **Later model control valve:** Using a suitable wrench, hold the flat surfaces on the cable guide tube in the vertical position.
3. **Both models:** Torque coupler nut to 35 lb. ft. (48 N·m).
4. **Earlier model control valve:** Install and tighten locking plate on coupler nut. Secure with self locking bolt and washer.

NOTE: *Later model control valves do not have a locking plate on the coupler nut.*

5. Install test gauge assembly between control valve and pump pressure hose. Tighten all fittings securely, but DO NOT OVERTIGHTEN.



22146

a - Pump Pressure Hose
b - Gauge Fitting
c - Gauge Valve Hose
d - Control Valve

Index

Power Steering Pump Lugging Test

⚠ CAUTION

DO NOT operate engine without cooling water being supplied to water pickup holes in gear housing, or over-heating damage to engine may result.

⚠ WARNING

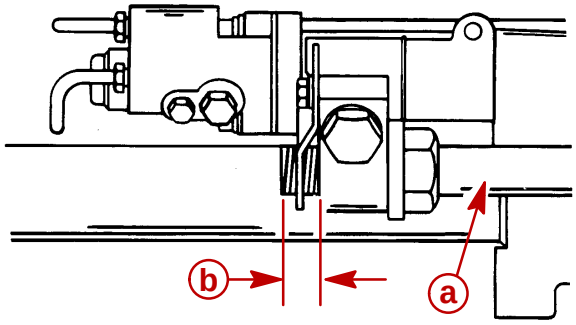
Steering cable outer casing MUST BE free to move back-and-forth for Power Steering to function properly. Make sure that no wires, cables, or other items are fastened to steering cable, as this may prevent it from moving.

⚠ CAUTION

If Power Steering pump lugs when steering wheel is turned to end of travel in either direction (left or right), damage to steering system and/or sterndrive may result.

IMPORTANT: Make sure that Power Steering pump is filled to proper level before proceeding.

1. Completely open test gauge.
2. Start engine and run at idle speed.
3. Turn steering wheel to **hard left** and observe reading on gauge. If pressure reading is higher than 300 psi (2069 kPa), stop engine and check the following:
   a. Check for an obstruction between gimbal ring and gimbal housing and all moving steering system components.
   b. Check that steering lever is not contacting cutout in transom. If contact is being made, modify cutout.
   c. Check steering cable guide tube dimensions and adjust as necessary.



22137

a - Steering Cable Guide Tube
b - 5/8-7/8 in. (16-22 mm) [Ideal 3/4 in. (19 mm)]

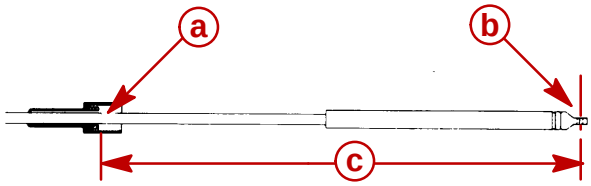
Index

4. With engine running, turn steering wheel to **hard right** and observe reading on gauge. If reading is higher than 300 psi (2069 kPa), stop engine and check the following.

   a. Check for an obstruction between gimbal ring, and gimbal housing and all moving steering system components.

   b. Check that steering lever is not contacting cutout in transom. If contact is being made, modify cutout.

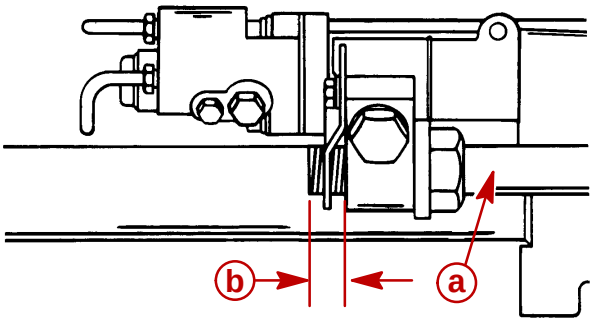
   c. Check steering cable end dimensions with cable fully extended. If excessive, replace cable and/or steering head as required.



22469

a - Steering Cable Mounting Flange
b - Center of Hole in Steering Cable End
c - 21-3/8 in. (543 mm)

   d. Check steering cable guide tube dimension and adjust as necessary.



22137

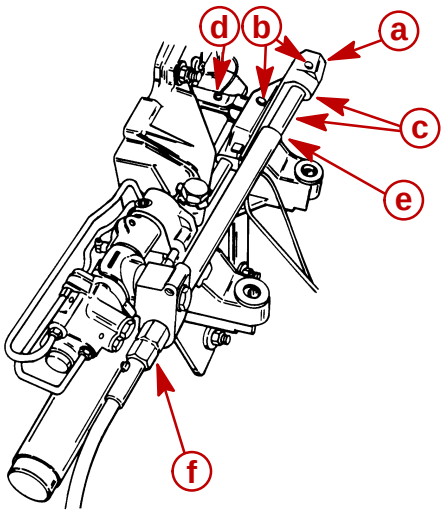
a - Steering Cable Guide Tube
b - 5/8-7/8 in. (16-22 mm) [Ideal 3/4 in. (19 mm)]

Power Steering System Pressure Test

IMPORTANT INFORMATION

The following instructions are arranged so that a defective part can be detected by the process of elimination. It is suggested that the order of the instructions be followed so that the Power Steering System can be tested effectively.

1. Remove steering cable from Power Steering unit and disconnect Power Steering unit from steering lever.

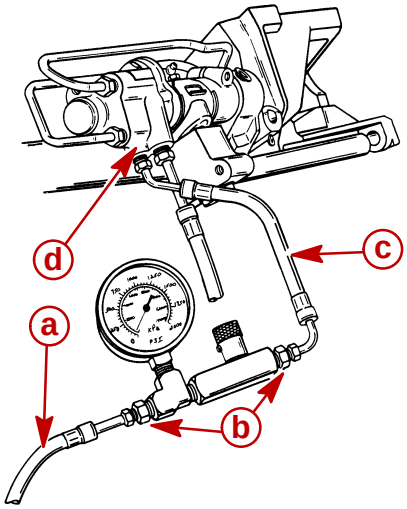


50912

a - Clevis
b - Pins (2)
c - Cotter Pins (2) - Hidden
d - Steering Lever
e - Steering Cable
f - Self-Locking Coupler Nut

2. Assemble and install test gauge.

3. Open valve on gauge completely.

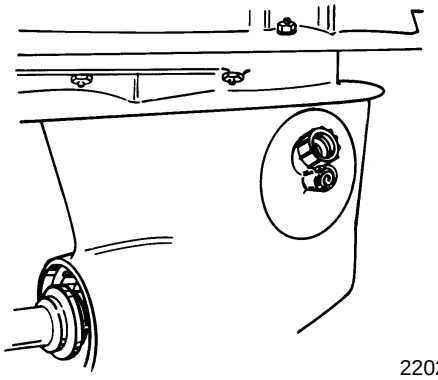


22146

a - Pump Pressure Hose
b - Gauge Fitting
c - Gauge Valve Hose
d - Control Valve

Index

4. Connect a flush test device to drive unit. Partially open water tap (approximately 1/2 max.) and allow cooling system to fill completely. Cooling system is full when water is discharged through the propeller. DO NOT use full water tap pressure.



22029

5. Start engine and run at 1000-1500 RPM until engine reaches normal operating temperature.
6. With engine at idle speed, test gauge reading should be between 70 and 125 psi (483 and 862 kPa). If not, proceed as follows:

If lower than 70 psi (483 kPa), proceed to “Pump Pressure Test,” see “Index.”

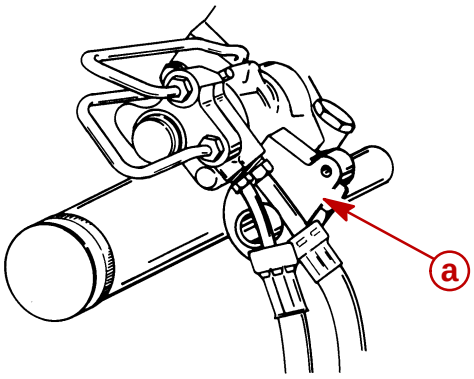
If higher than 125 psi (862 kPa), check for hose restrictions in the system.

⚠ CAUTION

DO NOT lug pump at maximum pressure for more than 5 seconds, in next step, or damage to Power Steering pump may occur.

7. Push control valve adaptor block **momentarily** to the **left** and then to the **right**. Gauge reading should show an instant increase in pressure when block is pushed in both directions.
8. Push control valve adaptor block to the **right**, until booster cylinder piston rod is fully retracted. With piston rod in this position, **momentarily** push adaptor block to the **right** until maximum pressure reading is obtained.

- **If pressure is above 1000 psi (6897 kPa),** system pressure is good.
- **If pressure is below 1000 psi (6897 kPa),** conduct “Pump Pressure Test,” see “Index.”



22023

a - Control Valve Adaptor Block

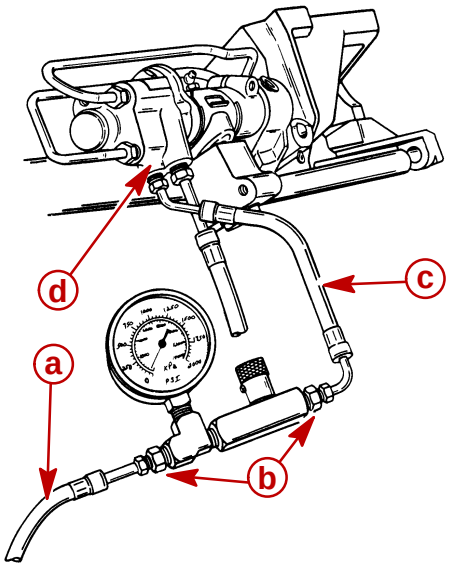
Index

Pump Pressure Test

⚠ CAUTION

In performing the following test, DO NOT lug pump at maximum pressure for more than 5 seconds or damage to Power Steering pump may occur.

1. Install test gauge.

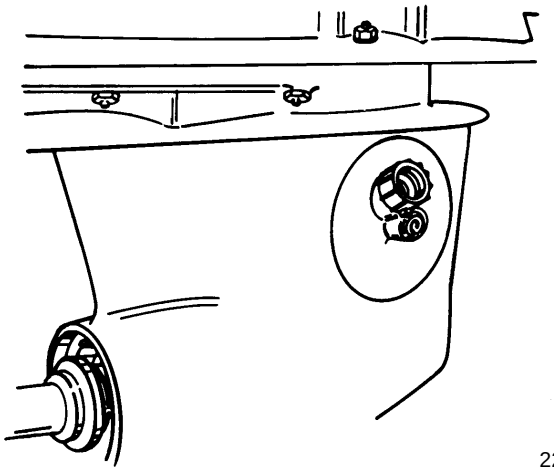


22146

a - Pump Pressure Hose
b - Gauge Fitting
c - Gauge Valve Hose
d - Control Valve

DO NOT operate engine without cooling water being supplied to water pickup holes in gear housing, or overheating damage to engine may result.

2. Connect a flush test device to drive unit. Partially open water tap (approximately 1/2 max.) and allow water to enter cooling system. DO NOT use full water tap pressure.



22029

3. Start engine and run at 1000-1500 RPM until engine reaches normal operating temperature.
4. Close test gauge valve just long enough to obtain maximum pressure reading.

Index

5. Close and open valve 3 times. Record highest pressure reading attained each time.

   a. **If pressure readings are between 1150 and 1250 psi (7932-8621 kPa) and are within a range of 50 psi (345 kPa),** the pump is within specifications. If the **pump** tests OK, but system pressure was low (as tested under “Power Steering System Pressure Test,” see “Index”), proceed to “Booster Cylinder Test,” see “Index.”

   b. **If pressure readings are between 1150-1250 psi (7932-8621 kPa), but are not within a 50 psi (345 kPa) range,** the Power Steering pump flow control valve is sticking or pump hydraulic system is dirty.

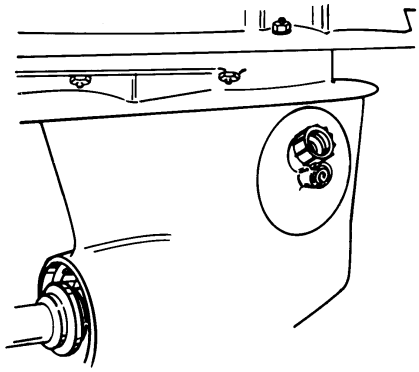
   c. **If pressure readings are constant, but below 1000 psi (6897 kPa),** replace Power Steering pump.

Booster Cylinder Test

⚠ CAUTION

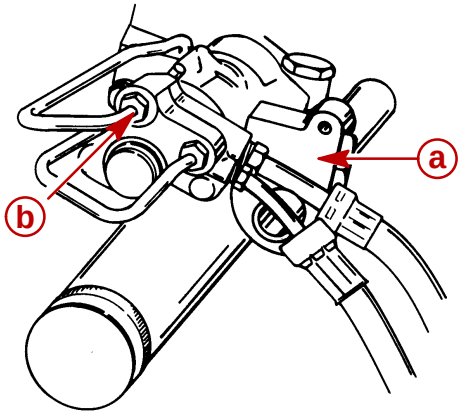
DO NOT operate engine without cooling water being supplied to water pickup holes in gear housing, or over-heating damage to engine may result.

1. Connect a flush test device to drive unit. Partially open water tap (approximately 1/2 max.) and allow water to enter cooling system. DO NOT use full water tap pressure.



22029

2. Start engine.
3. Push control valve adaptor block to the right until booster cylinder rod is fully retracted.
4. Stop engine.
5. Remove top metal hydraulic line from control valve.
6. Plug port in control valve and cap end of metal line with cap and plug supplied in test gauge kit.



22023

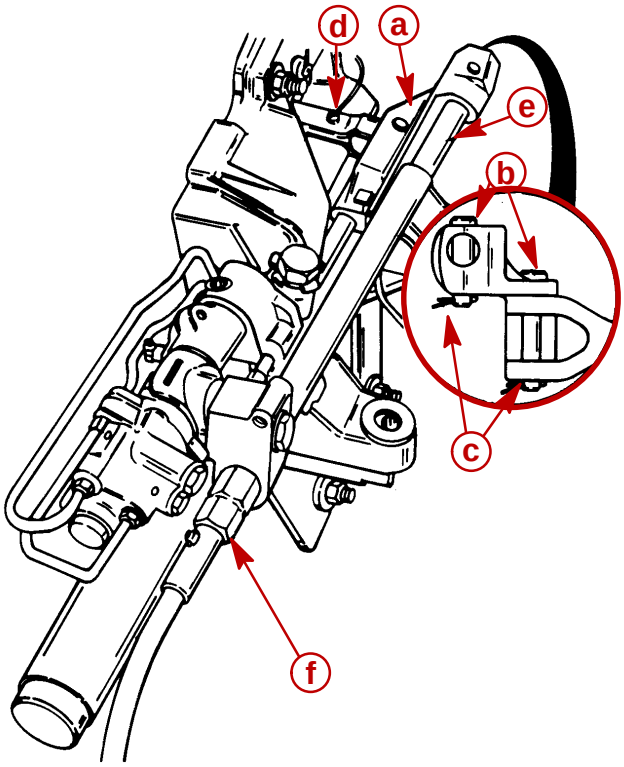
a - Adaptor Block - Push to Right
b - Top Metal Line

Index

⚠ CAUTION

DO NOT lug pump at maximum pressure for more than 5 seconds, in next step, or damage to Power Steering pump may occur.

7. Start engine.
8. Push control valve adaptor block **momentarily** to the right and observe for conditions “a” or “b,” following:
   a. **If piston rod extends,** booster cylinder is leaking and must be replaced. After replacement, repeat “Power Steering System Pressure Test.” If pressure is still low, replace control valve.
   b. **If piston rod does not extend, but pressure was low when performing “Power Steering System Pressure Test,”** replace control valve.
9. Stop engine.
10. Connect power steering piston rod clevis to drive unit steering lever. Secure with pin and cotter pin.
11. Apply a liberal amount of Special Lubricant 101 to end of steering cable and install cable end in clevis. Secure with pin and cotter pin.
12. Torque self-locking coupler nut to 35 lb. ft. (48 N·m).



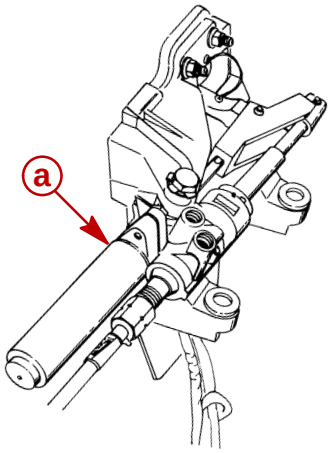
50927

a - Clevis
b - Pins (2)
c - Cotter Pins (2)
d - Steering Lever
e - Steering Cable
f - Self-Locking Coupler Nut

Index

Power Steering Component Repair

NOTE: *DO NOT attempt to repair or adjust the later model control valve.*



22217

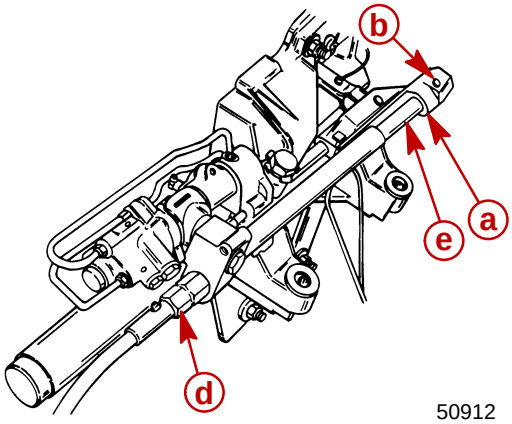
Later Model Control Valve

a - Later Model Control Valve (Do Not Repair or Adjust)

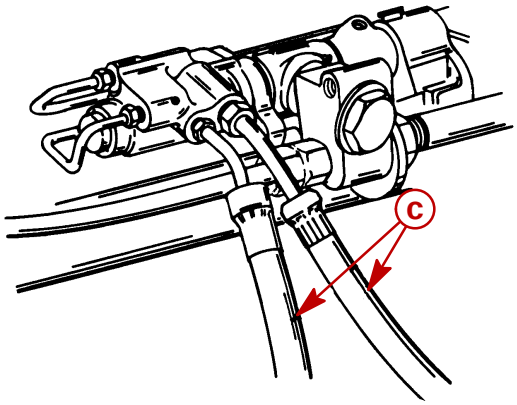
Power Steering Unit

REMOVAL

1. Remove steering cable and Power Steering pump fluid hoses.



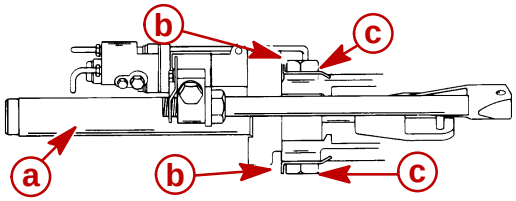
50912



50912

a - Cotter Pin (Hidden)
b - Clevis Pin
c - Power Steering Pump Fluid Hoses - Remove and Plug
d - Self-Locking Cable Coupler Nut
e - Steering Cable

2. Remove Power Steering unit.



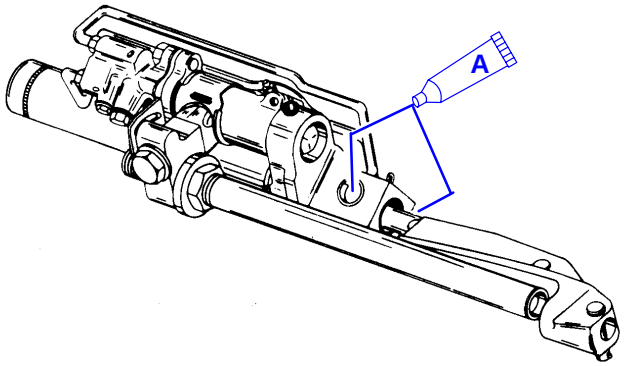
22137

a - Power Steering Unit
b - Tab Washer - Bend Tab Away from Pivot Bolt
c - Pivot Bolt

Index

INSTALLATION

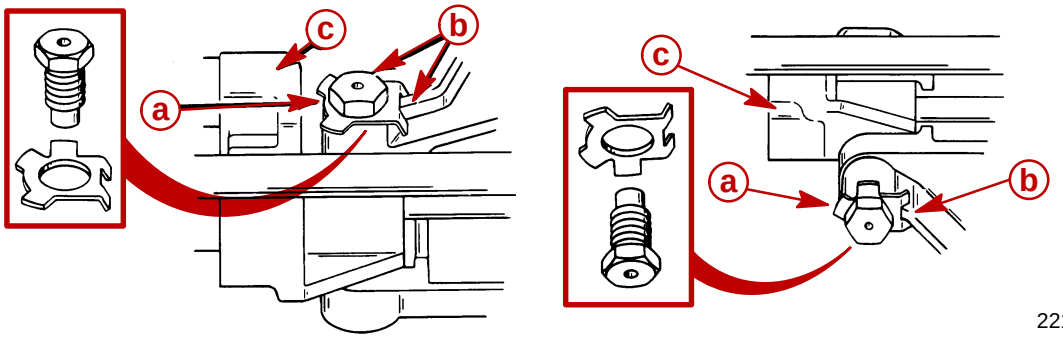
1. Lubricate power steering unit bushings.



22167

a - Bushings - Lubricate with Special Lubricant 101

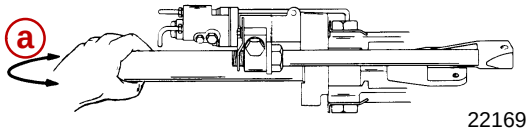
2. Lubricate pivot bolts with Special Lubricant 101.
3. HAND THREAD pivot bolts all-the-way into inner transom plate and swivel ring. DO NOT use a wrench.
4. Straddle tab washer tangs on inner transom plate ridge.



22168

a - Pivot Bolts - HAND THREAD into Transom Plate and Power Steering Unit
b - Tab Washer - Straddle Inner Transom Plate Ridge
c - Swivel Ring

5. Torque pivot bolts to 25 lb. ft. (35 N·m). Bend washer tabs against corresponding flats on bolt tabs.
6. Move power steering unit back-and-forth to ensure that it pivots freely.

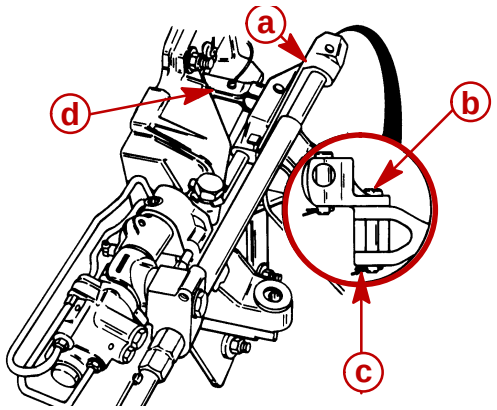


22169

a - Move Power Steering Unit Back-and-Forth

Index

7. Connect power steering piston rod clevis to drive unit steering lever. Secure with pin and cotter pin.

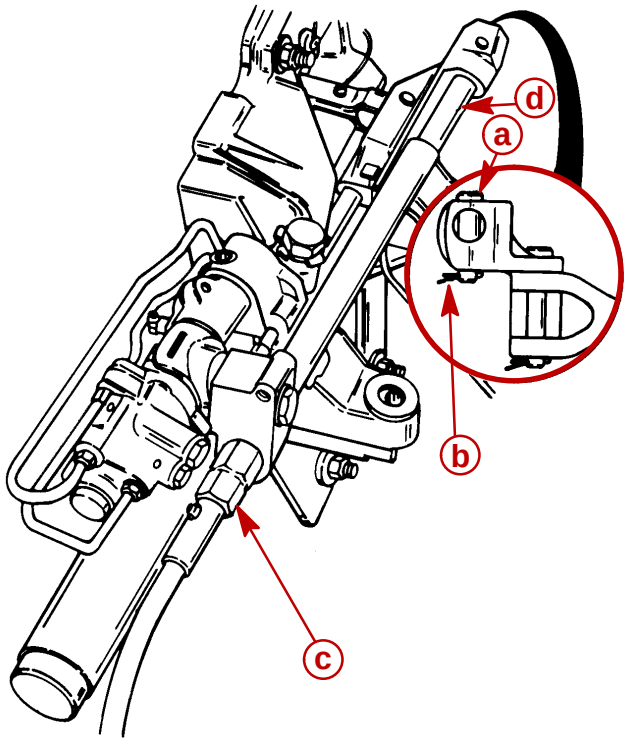


50927

a - Clevis
b - Pin
c - Cotter Pin
d - Steering Lever

8. Apply a liberal amount of Special Lubricant 101 to end of steering cable and install cable end in clevis. Secure with pin and cotter pin.

9. Torque self-locking coupler nut to 35 lb. ft. (48 N·m).

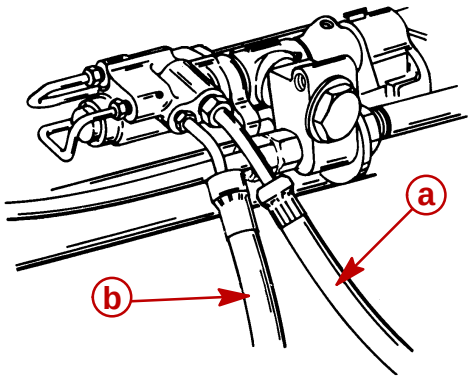


50927

a - Clevis Pin
b - Cotter Pin
c - Self-Locking Coupler Nut
d - Steering Cable

Index

10. Connect power steering pump hoses to their respective fittings on control valve.



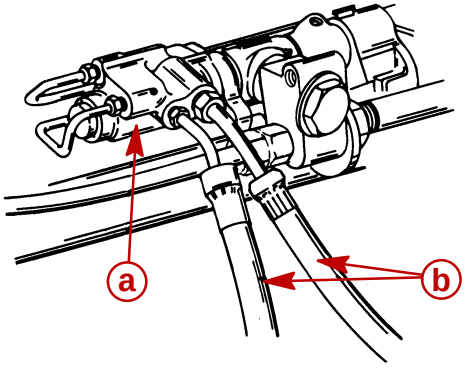
50912

a - Hose (Large Fitting) - Torque to 20-25 lb. ft. (27-34 N·m)
b - Hose (Small Fitting) - Torque to 96-108 lb. in. (11-12 N·m)

Cable Guide Tube (Early Style Only)

REMOVAL

1. Remove power steering pump hoses from control valve. Cap hoses and plug holes in control valve.

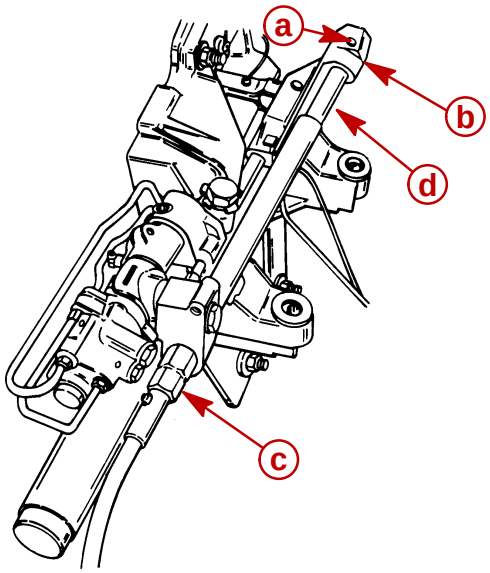


50912

a - Control Valve
b - Pump Hoses

2. Remove steering cable from power steering control valve.

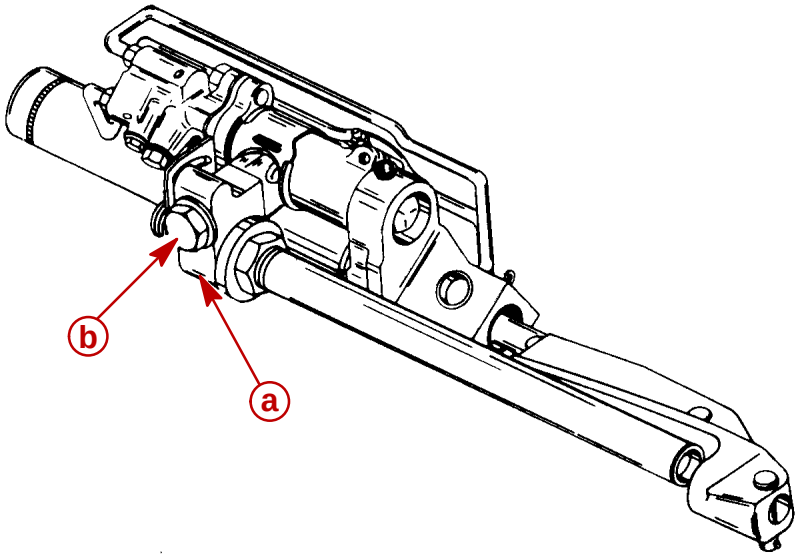
Index



50912

a - Clevis Pin
b - Cotter Pin (Hidden)
c - Self-Locking Coupler Nut
d - Steering Cable

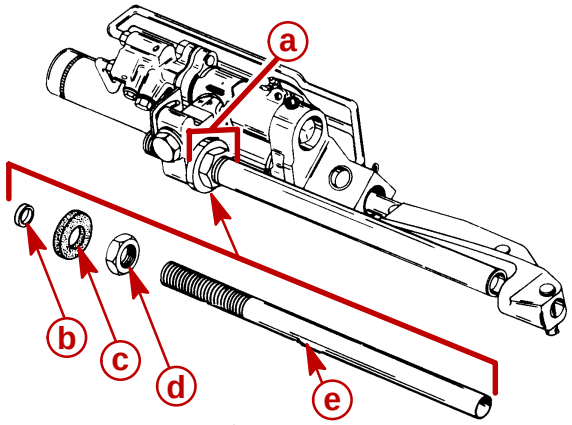
3. Remove adaptor block as follows:
   a. Loosen adaptor block nut.
   b. Tap adaptor nut with hammer to loosen block.
   c. Remove nut; then remove block.



22137

a - Adaptor Block
b - Nut

4. Heat area shown (to break down Loctite), and remove steering tube bushing, guide, and nut. Remove cable guide tube.



22137

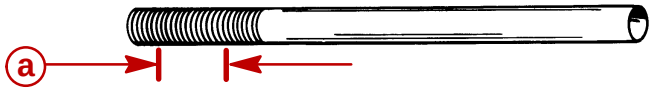
a - Heat in This Area
b - Steering Tube Bushing
c - Steering Tube Guide
d - Steering Tube Nut
e - Cable Guide Tube

INSTALLATION

⚠ WARNING

Loctite MUST BE applied to cable guide tube threads to prevent tube from loosening during operation.

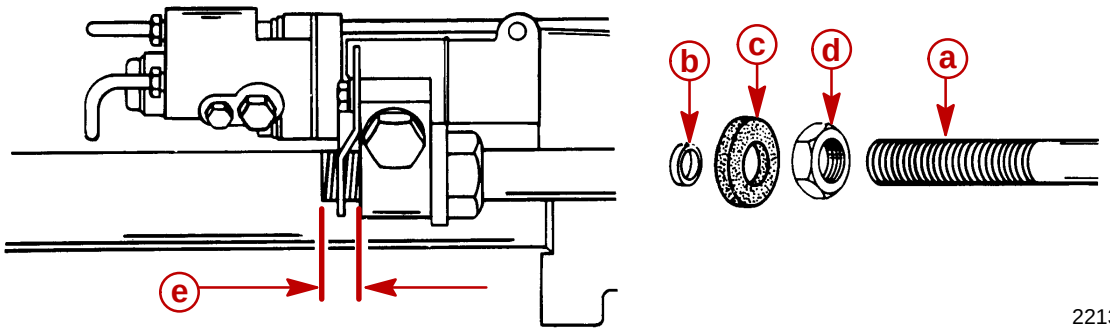
1. Clean guide tube threads with a wire brush to remove old Loctite. Apply Quicksilver Loctite 8831 or 271 to guide tube threads in the area where adaptor block and locknut will be installed.



22137

a - Apply Loctite 8831 or 271 to Threads of Cable Guide Tube

2. Reinstall steering tube and related hardware and position so that threaded end of tube protrudes exactly 3/4 in. (19 mm) through adaptor block. Torque steering tube nut to 40 lb. ft. (54 N·m).

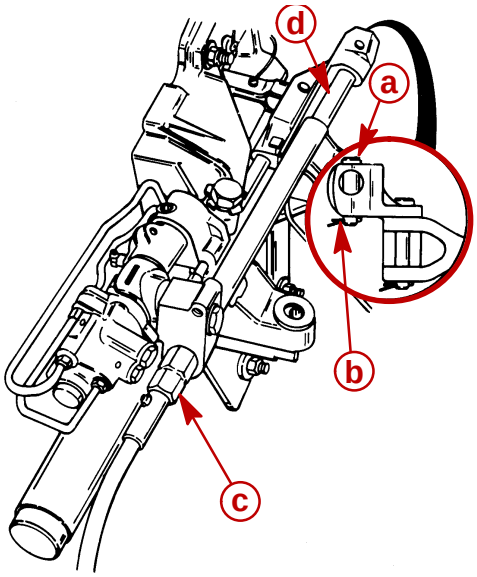


22137

a - Steering Guide Tube
b - Steering Tube Bushing
c - Steering Tube Guide
d - Steering Tube Nut
e - 3/4 in. (19 mm)

Index

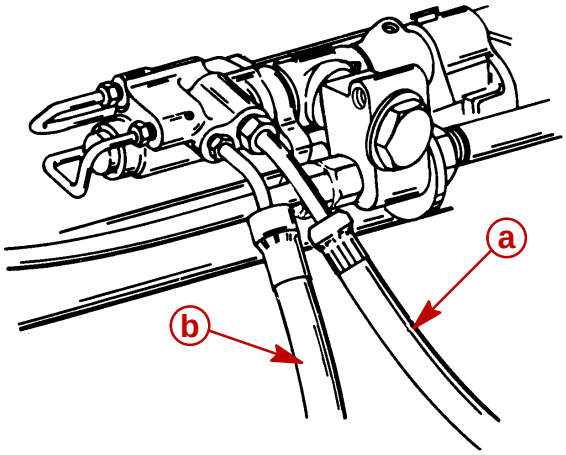
3. Apply a liberal amount of Special Lubricant 101 to end of steering cable and install cable end in clevis. Secure with pin and cotter pin.
4. Torque self-locking coupler nut to 35 lb. ft. (48 N·m).



50927

a - Clevis Pin
b - Cotter Pin
c - Self-Locking Coupler Nut
d - Steering Cable

5. Connect power steering pump hoses to their respective fittings on control valve.



50912

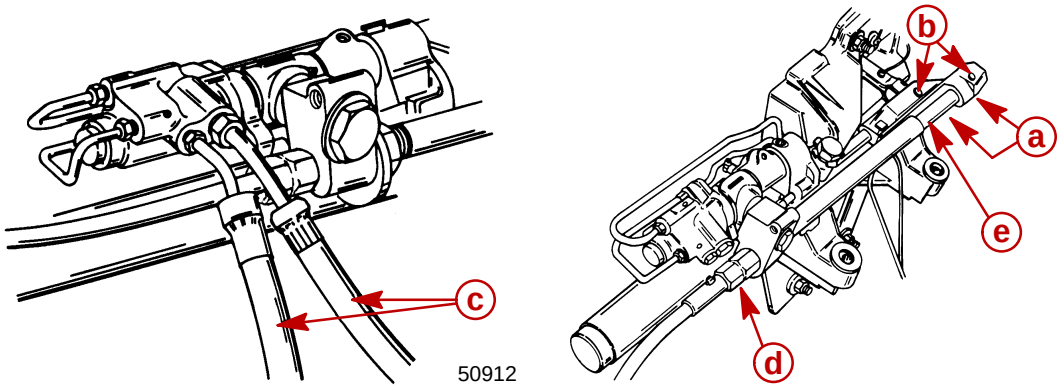
a - Hose (Large Fitting) - Torque to 20-25 lb. ft. (27-34 N·m)
b - Hose (Small Fitting) - Torque to 96-108 lb. in. (11-12 N·m)

Control Valve (Early Style Only)

NOTE: *If accessibility to control valve area is limited, remove Power Steering unit from transom assembly, to gain easier access to control valve.*

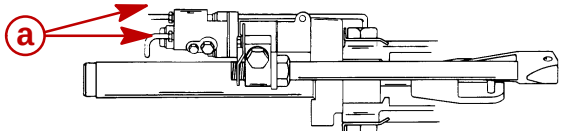
REMOVAL

1. Remove steering cable and Power Steering pump fluid hoses.



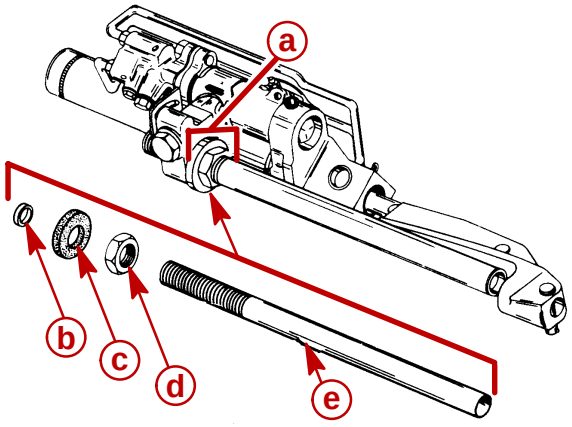
a - Cotter Pins (Hidden)
b - Clevis Pins
c - Power Steering Pump Fluid Hoses - Remove and Plug
d - Cable Self-Locking Coupler Nut
e - Steering Cable

2. Remove tubes from control valve.



a - Metal Tubes

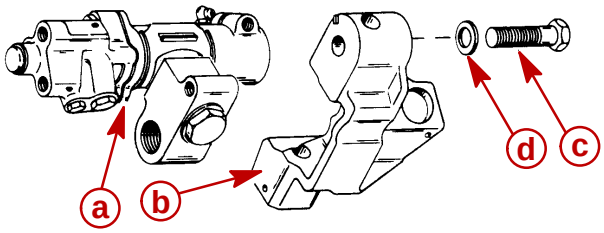
3. Heat area shown (to breakdown Loctite), and remove steering tube bushing, guide and nut.



a - Heat this Area
b - Steering Tube Bushing
c - Steering Tube Guide
d - Steering Tube Nut
e - Cable Guide Tube

Index

4. Remove control valve from adaptor block assembly.

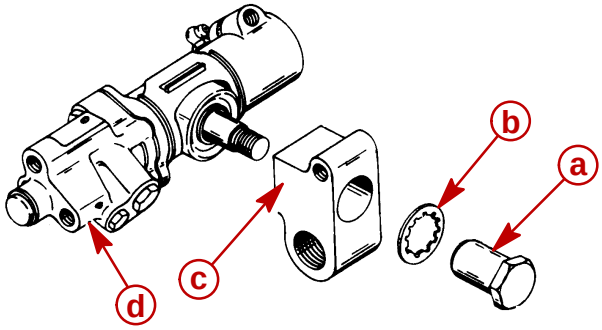


22143

a - Control Valve
b - Adaptor Block Assembly
c - Screw
d - Washer

DISASSEMBLY

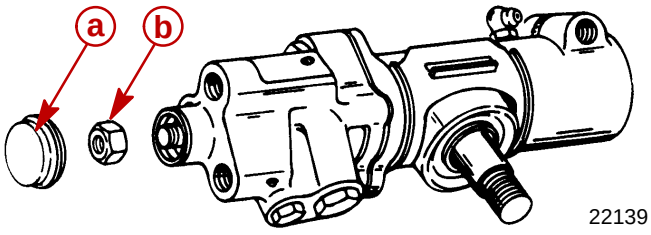
1. Remove adaptor block as follows:
   Loosen adaptor block nut. Tap adaptor nut with hammer to loosen block. Remove nut, washer and adaptor block.



22143

a - Adaptor Block Nut
b - Washer
c - Adaptor Block
d - Control Valve

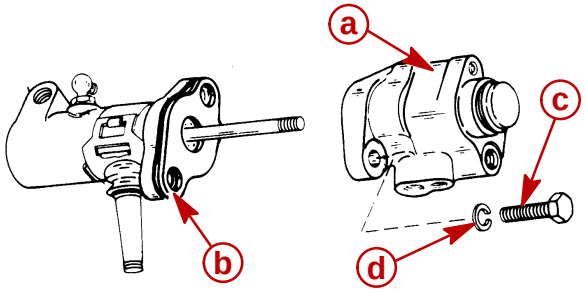
2. Remove dust cover and adjusting nut.



22139

a - Dust Cover
b - Adjusting Nut

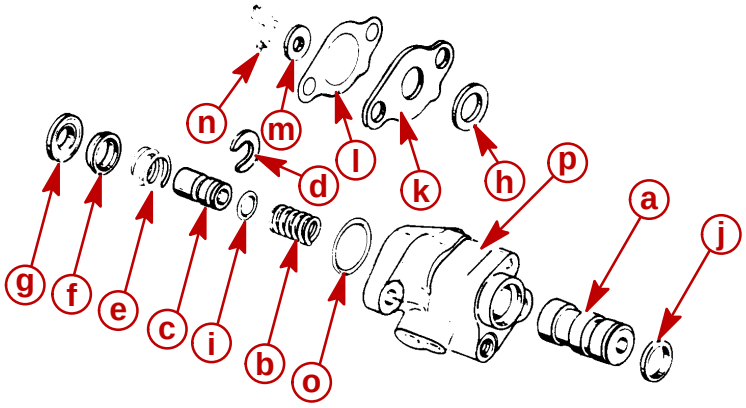
3. Separate valve housing from adaptor.



22145

a - Valve Housing
b - Adaptor
c - Screws (2)
d - Lockwashers (2)

4. Remove components shown.

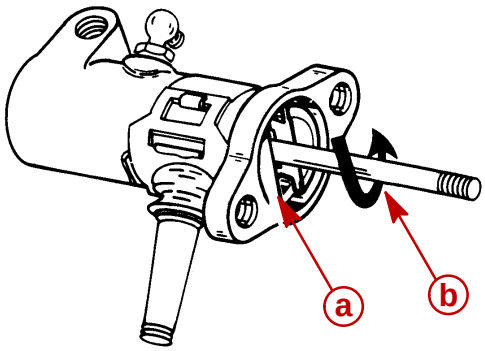


22138

a - Valve Spool
b - Valve Adjustment Spring
c - Reaction Spool
d - Spring Thrust Washer
e - Valve Spring
f - Spring Retainer
g - Annulus Seal
h - Large ID Washer
i - Reaction Spool O-ring
j - Valve Spool “V” Block Seal
k - Annulus Spacer
l - Gasket
m - Small Washer
n - Plug to Sleeve Key
o - O-ring
p - Valve Housing

Index

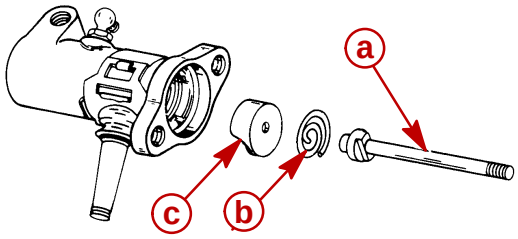
5. Carefully (so as not to nick the top surface) turn adjuster plug out of sleeve.



22139

a - Adjuster Plug
b - Turn Counterclockwise

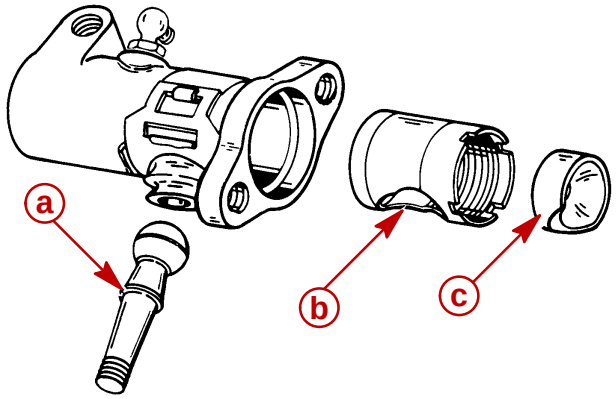
6. Remove components shown.



22139

a - Valve Shaft
b - Ball Seal Spring
c - Upper Ball Seat

7. Remove sleeve bearing and lower ball seat.



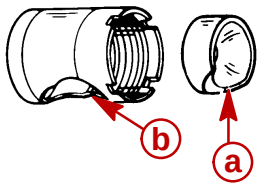
22140

a - Ball Stud - Pull Up into Rubber Boot
b - Sleeve Bearing
c - Lower Ball Seat

8. Clean and inspect metal parts. If any metal part shows signs of wear, replace control valve assembly.

REASSEMBLY

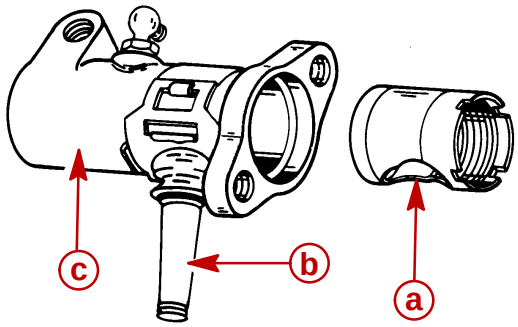
1. Install lower ball seat into sleeve bearing.



22140

a - Lower Ball Seat
b - Sleeve Bearing

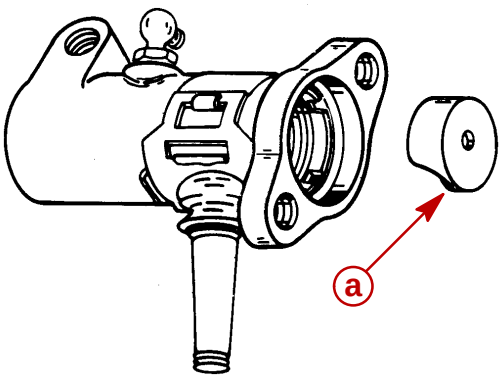
2. Install sleeve bearing.



22140

a - Sleeve Bearing
b - Ball Stud - Pull Up into Rubber Boot
c - Adaptor Housing

3. Position ball stud in sleeve bearing.
4. Install upper ball seat.

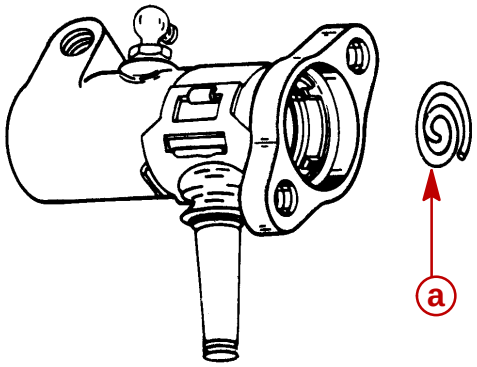


22141

a - Upper Ball Seat

Index

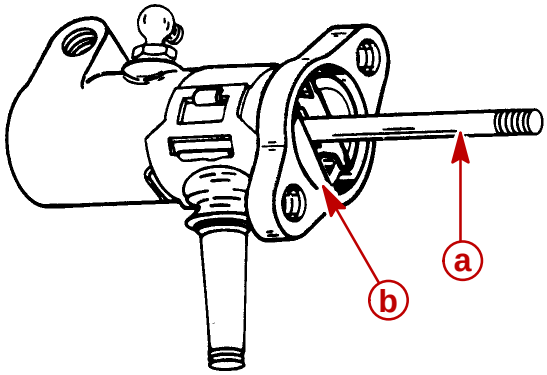
5. Install ball seat spring.



22141

a - Ball Seat Spring - Small Coil Down

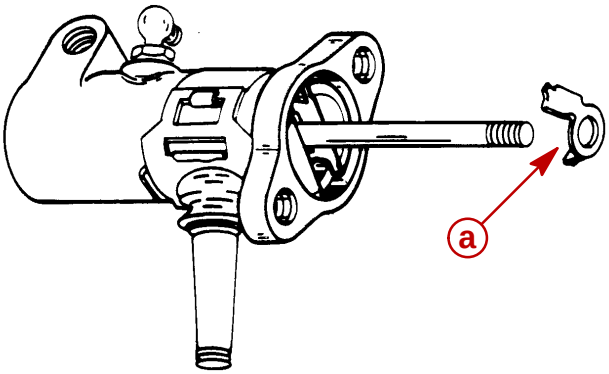
6. Insert valve shaft into adjuster plug. Screw adjuster plug into sleeve until tight; then back-off plug until slot lines up with notches in sleeve.



22139

a - Valve Shaft
b - Adjuster Plug

7. Install key.

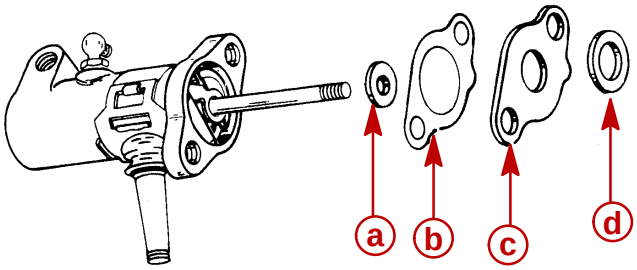


22141

a - Key - Tangs on Key to Fit into Notches in Sleeve

Index

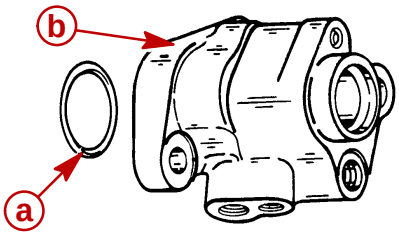
8. Install components shown.



22141

a - Valve Shaft Washer
b - Gasket
c - Annulus Spacer
d - Large ID Washer

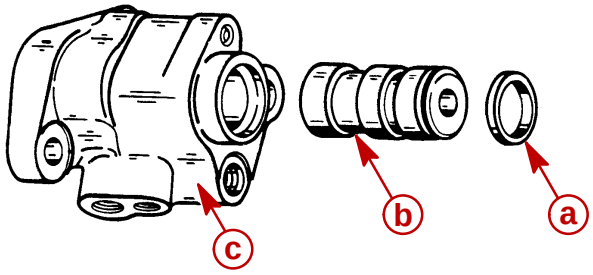
9. Install O-ring in control valve housing.



22142

a - O-ring
b - Control Valve Housing

10. Install “V” block seal. Insert valve spool into adjusting nut end of control valve.

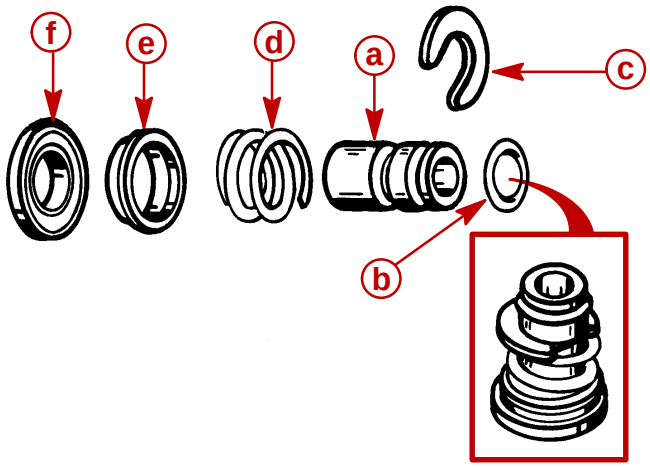


22142

a - “V” Block Seal - Lip of Seal Facing Lands on Spool
b - Spool
c - Control Valve

Index

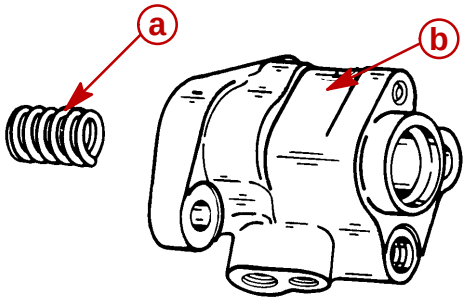
11. Assemble reaction spool.



22142

a - Reaction Spool
b - O-ring
c - Thrust Washer
d - Valve Spring
e - Spring Retainer
f - Annulus Seal - Lip Facing O-ring End of Spool

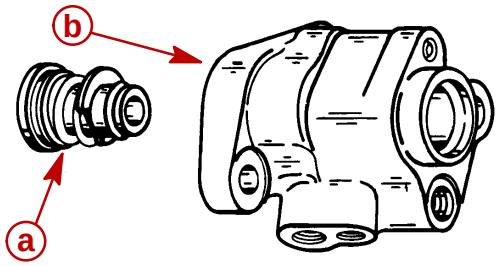
12. Install valve adjustment spring.



22142

a - Valve Adjustment Spring
b - Control Valve

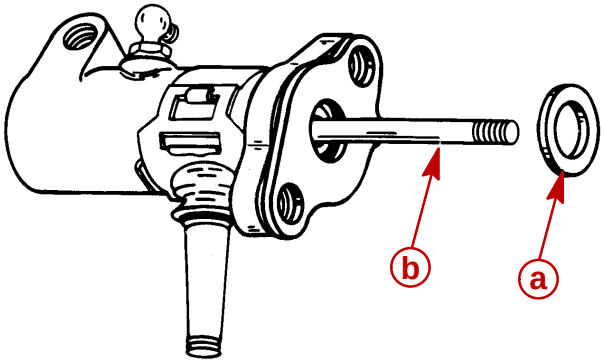
13. Install reaction spool assembly into larger control valve cavity.



22142

a - Reaction Spool Assembly
b - Control Valve - Large Cavity

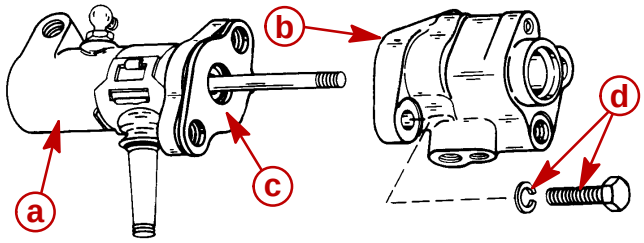
14. Install large ID washer.



22144

a - Large ID Washer
b - Valve Shaft

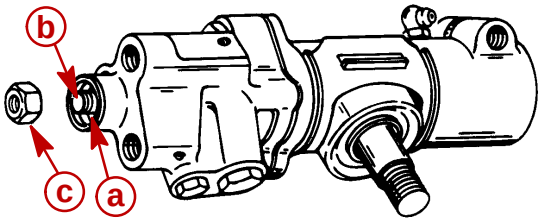
15. Match annulus spacer to control valve housing. Secure adaptor housing to control valve housing.



22144

a - Annulus Spacer
b - Control Valve Housing
c - Adaptor Housing
d - Screws and Washers (2 Each) - Torque Screws to 20-30 lb. ft. (27-41 N·m)

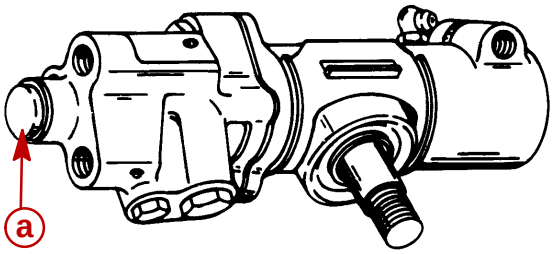
16. Depress valve spool. Install locknut-thread about 4 turns.



22139

a - Valve Spool
b - Valve Shaft
c - Locknut

17. Install dust cover.

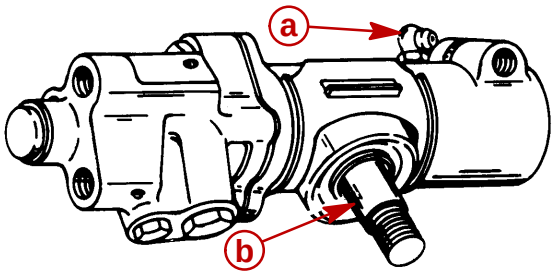


22143

a - Dust Cover

Index

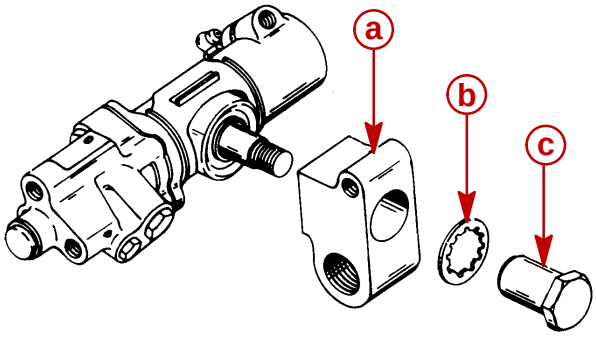
18. Lubricate control valve with Quicksilver 2-4-C Multi-Lube until lubricant appears around rubber boot.



22143

a - Grease Fitting
b - Rubber Boot

19. Install adaptor block.

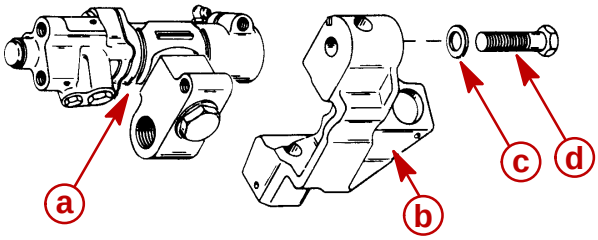


22143

a - Adaptor Block
b - Internal Lockwasher
c - Nut - Torque to 30-40 lb. ft. (41-54 N·m)

INSTALLATION

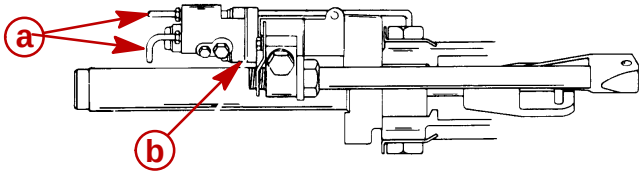
1. Secure control valve to adaptor block assembly.



22143

a - Control Valve
b - Adaptor Block Assembly
c - Washer
d - Screw- Torque to 25-35 lb. ft. (34-47 N·m)

2. Install metal tubes onto control valve.



22137

a - Metal Tubes - Tighten Securely BUT DO NOT OVERTIGHTEN
b - Control Valve

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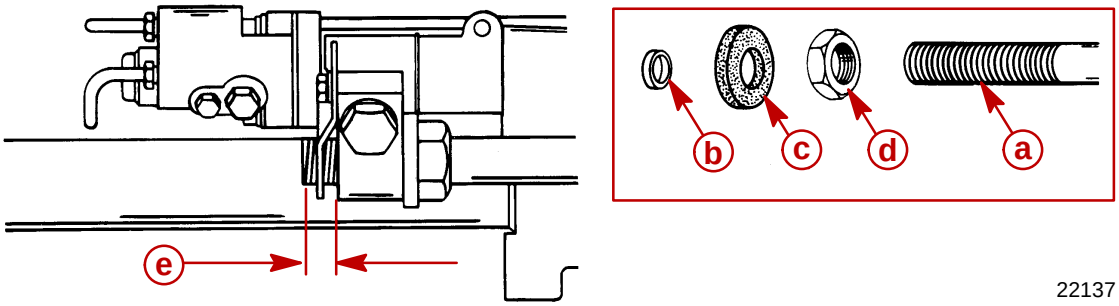
⚠ WARNING

Loctite MUST BE applied to cable guide tube threads to prevent tube from loosening during operation.

3. Clean guide tube threads with a wire brush to remove old Loctite. Apply a liberal amount of Loctite 8831 or 271 to guide tube threads in the area where adaptor block and locknut will be installed.

a - Apply Loctite 8831 or 271 to Threads of Cable Guide Tube

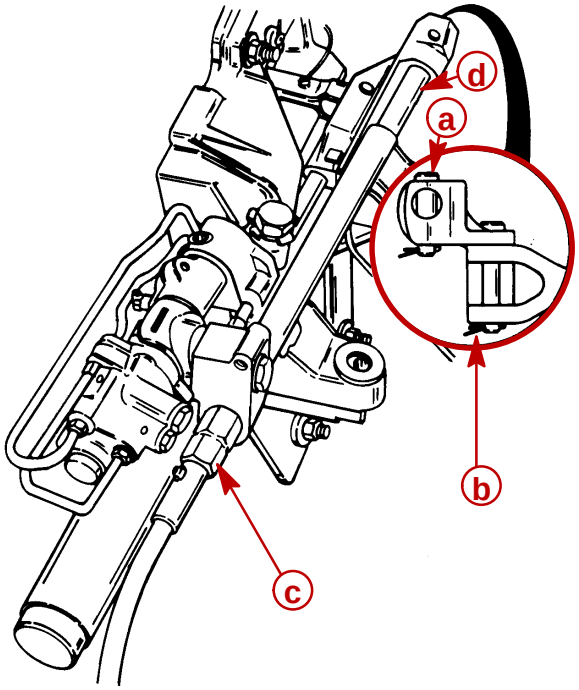
4. Reinstall steering tube and related hardware and position so that threaded end of tube protrudes exactly 3/4 in. (19 mm) through adaptor block. Torque steering tube nut to 40 lb. ft. (54 N·m).



a - Steering Guide Tube
b - Steering Tube Bushing
c - Steering Tube Guide
d - Steering Tube Nut
e - 3/4 in. (19 mm)

5. Apply a liberal amount of Special Lubricant 101 to end of steering cable and install cable end in clevis. Secure with pin and cotter pin.

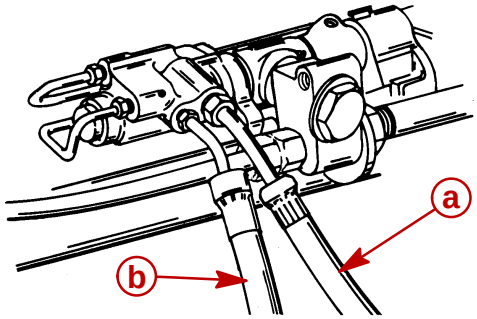
6. Torque self-locking coupler nut to 35 lb. ft. (48 N·m).



50927

a - Clevis Pin
b - Cotter Pin
c - Self-Locking Coupler Nut
d - Steering Cable

7. Connect power steering pump hoses to their respective fittings on control valve.



50912

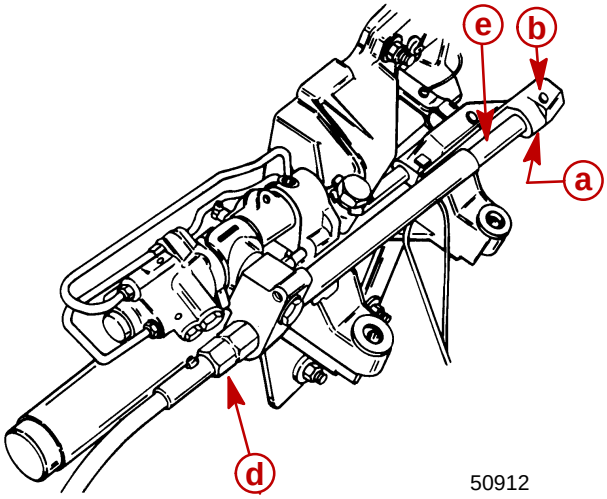
a - Hose (Large Fitting) - Torque to 20-25 lb. ft. (27-34 N·m)
b - Hose (Small Fitting) - Torque to 96-108 lb. in. (11-12 N·m)

Booster Cylinder (Early Style Only)

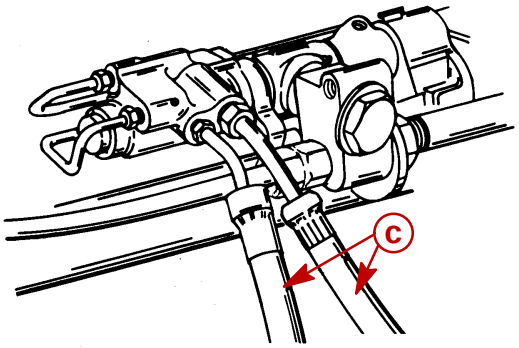
REMOVAL

NOTE: *If accessibility to booster cylinder area is limited, remove Power Steering unit from transom assembly to gain easier access to booster cylinder.*

1. Remove steering cable and Power Steering pump fluid hoses.



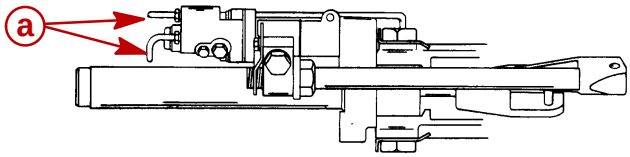
50912



50912

a - Cotter Pin (Hidden)
b - Clevis Pin
c - Power Steering Pump Fluid Hoses - Remove and Plug
d - Self-Locking Cable Coupler Nut
e - Steering Cable

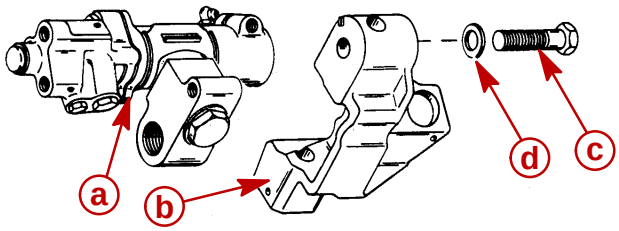
2. Remove metal lines from control valve.



22137

a - Metal Lines

3. Remove control valve from adaptor block assembly.



22143

a - Control Valve
b - Adaptor Block Assembly
c - Screw
d - Washer

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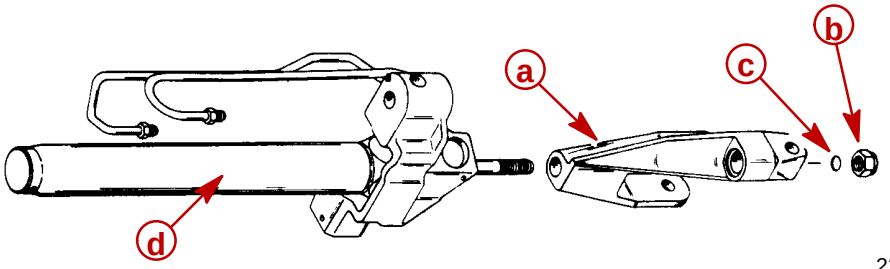
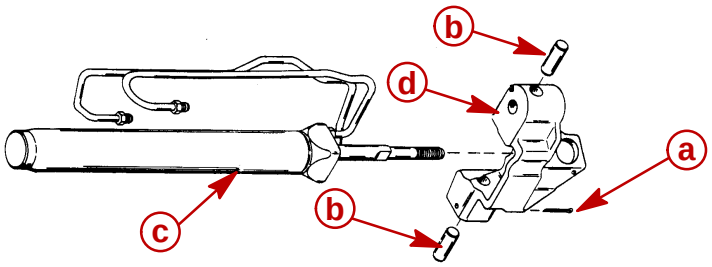
4. Remove clevis assembly.



22157

a - Clevis Assembly
b - Nut
c - Washer
d - Booster Cylinder

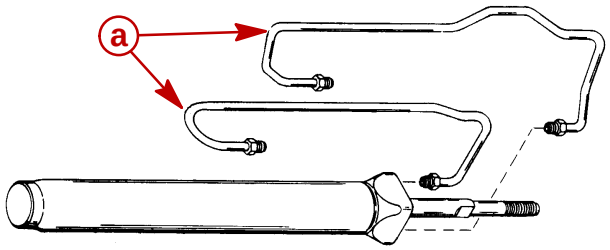
5. Separate booster cylinder from adaptor block assembly.



22158

a - Cotter Pin
b - Retaining Pins (2) - Thread a Screw of Appropriate Length and Thread into Pins and Remove
c - Booster Cylinder
d - Adaptor Block Assembly

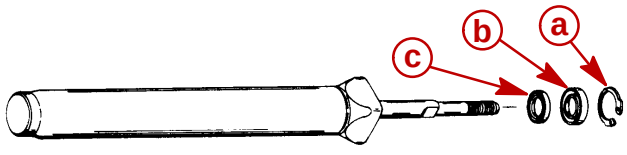
6. Remove lines from booster cylinder.



22157

a - Metal Lines

7. Remove components shown.



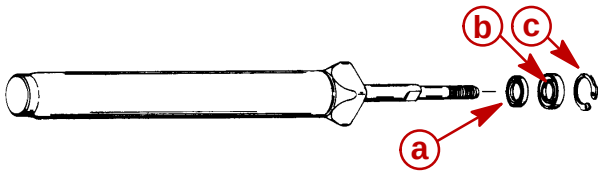
22149

a - Snap Ring
b - Large Oil Seal
c - Small Oil Seal

Index

INSTALLATION

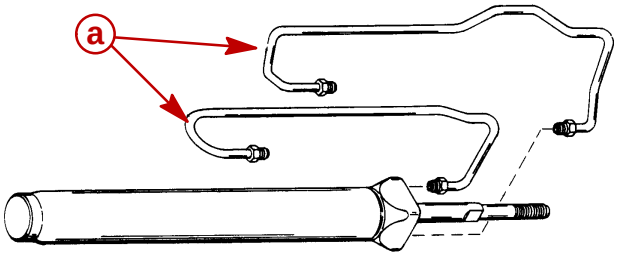
1. Install components shown.



22149

a - Small Oil Seal - Lip In
b - Large Oil Seal - Lip Out
c - Snap Ring - Install In Groove

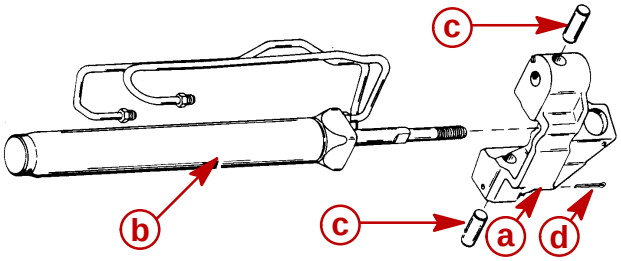
2. Install metal lines.



22157

a - Metal Lines - Tighten Securely, BUT DO NOT OVERTIGHTEN

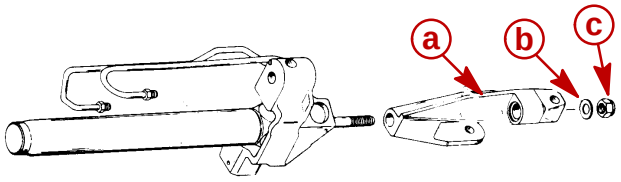
3. Install adaptor block assembly.



22158

a - Adaptor Block Assembly
b - Booster Cylinder
c - Retaining Pins
d - Cotter Pin - Spread Both Ends

4. Install clevis assembly.

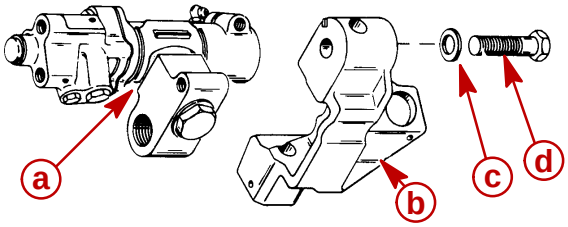


22157

a - Clevis Assembly
b - Washer
c - Nut - Tighten Securely

Index

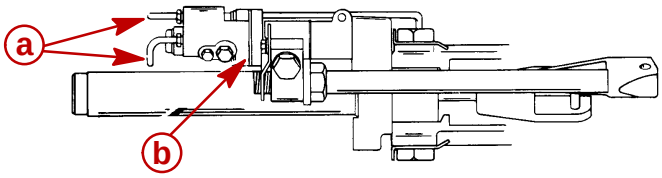
5. Secure control valve to adaptor block assembly.



22143

a - Control Valve
b - Adaptor Block Assembly
c - Washer
d - Screw - Torque to 25-35 lb. ft. (34-47 N·m)

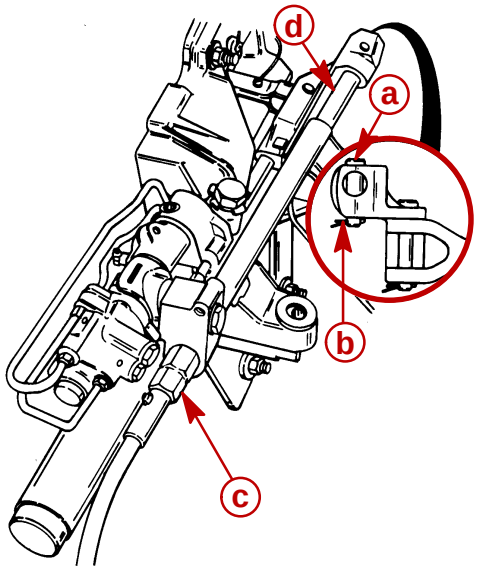
6. Install metal lines onto control valve.



22137

a - Metal Lines - Tighten Securely BUT DO NOT OVER-TIGHTEN
b - Control Valve

7. Apply a liberal amount of Special Lubricant 101 to end of steering cable and install cable end in clevis. Secure with pin and cotter pin.
8. Torque self-locking coupler nut to 35 lb. ft. (48 N·m).

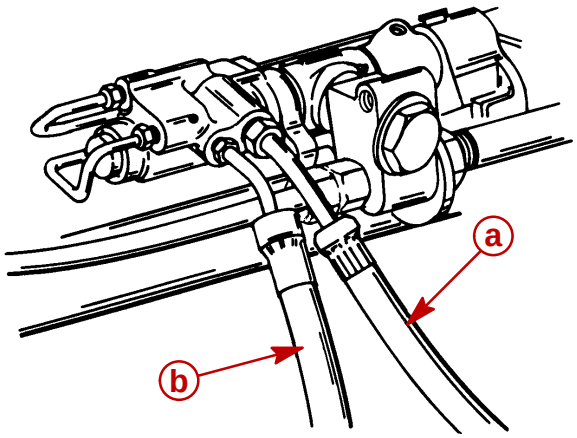


50927

a - Clevis Pin
b - Cotter Pin
c - Self-Locking Coupler Nut
d - Steering Cable

Index

9. Connect power steering pump hoses to their respective fittings on control valve.



50912

a - Hose (Large Fitting) - Torque to 20-25 lb. ft. (27-34 N·m)
b - Hose (Small Fitting) - Torque to 96-108 lb. in. (11-12 N·m)

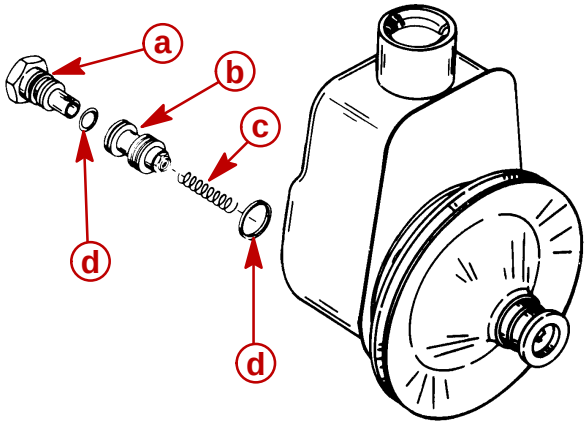
Power Steering Pump

Removal

1. Disconnect hoses at pump. Cap hose and fittings.
2. Loosen pump bolts at engine to remove pump belt.
3. Remove bracket from pump.

Flow Control Valve Servicing

1. Drain fluid from pump.
2. Remove components shown.



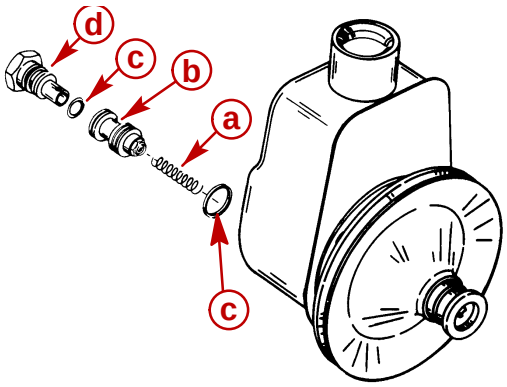
22149

a - Fitting Assembly
b - Control Valve Assembly
c - Flow Control Spring
d - O-rings

3. Inspect control valve assembly and fitting assembly.

Index

4. Install components shown.

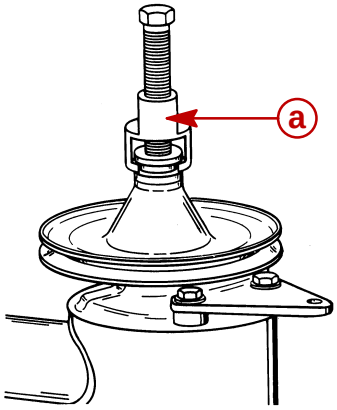


22149

a - Flow Control Spring
b - Control Valve Assembly
c - New O-rings
d - Fitting Assembly - Torque to 35 lb. ft. (47 N·m)

Pump Shaft Oil Seal Replacement

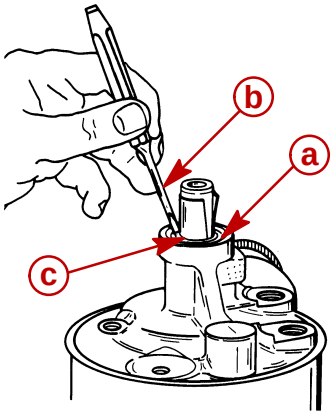
1. Remove pump pulley.



22149

a - Kent Moore Pulley Removal Tool (J-25034)

2. Push a .005 in. (0.13 mm) shim stock past oil seal until it bottoms in pump body (approximately 2-1/2 in. [64 mm] long).
3. Cut seal and tear metal body approximately 1 in. (25 mm).

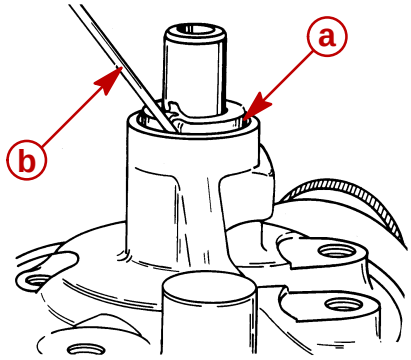


22152

a - Oil Seal
b - Chisel - To Cut Seal
c - Shim Stock

Index

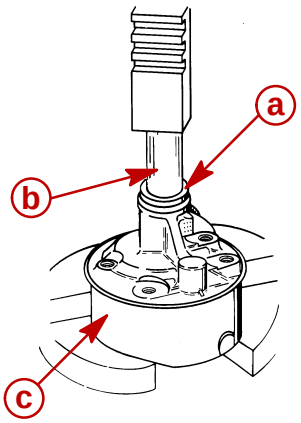
4. Remove oil seal. Remove shim stock.



22152

a - Torn Seal
b - Awl - Force Between Pump Housing and Seal, then, Pry Out

5. Install new oil seal.

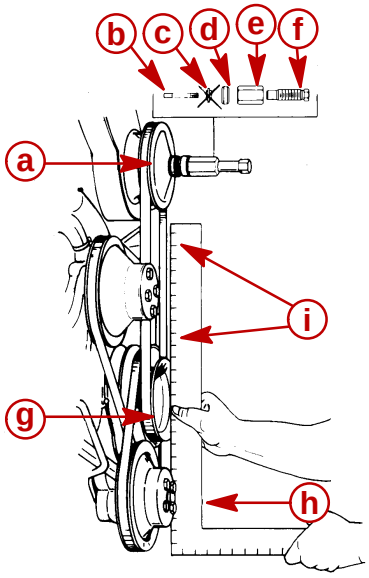


22151

a - New Oil Seal - Metal Side Up
b - 1 in. Socket
c - Pump Reservoir - Properly Support so Reservoir Back Does Not Distort

Index

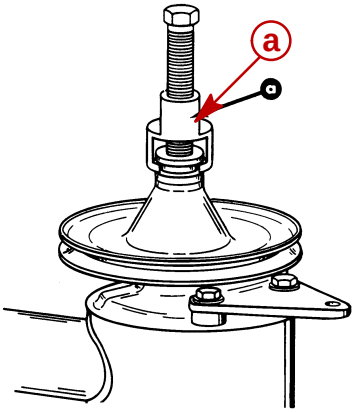
6. Install pulley, as follows, using Pulley Pusher Assembly 91-93656A1, and a long straight edge:
   a. Place pulley on pump shaft.
   b. Thread stud ALL-THE-WAY into pump shaft. Place bearing over stud. DO NOT use spacer from kit.
   c. Thread nut onto shaft. Thread shaft (and nut) ALL-THE-WAY onto stud.
   d. Using a long straight edge (to check drive belt alignment), turn large pusher nut until drive belt is parallel to straight edge.
   e. Check pulley installation for correct alignment.



a - Power Steering Pump Pulley
b - Stud
c - DO NOT Use Spacer
d - Bearing
e - Nut
f - Shaft
g - Crankshaft Pulley (Shown) or Water Circulating Pump Pulley
h - Long Straight Edge
i - Drive Belt Parallel

Disassembly

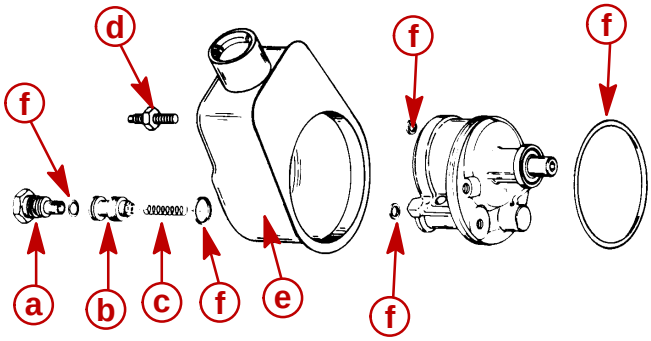
1. Drain fluid from pump.
2. Remove pump pulley.



22149

a - Kent Moore Pulley Removal Tool (J-25034)

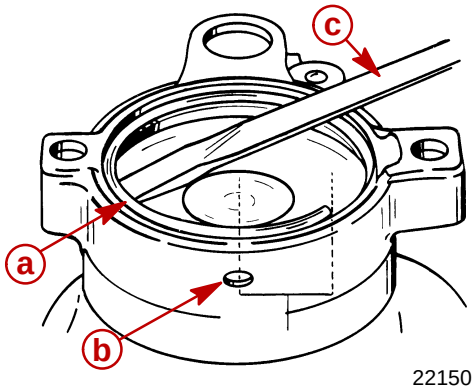
3. Remove reservoir.



22155

a - Fitting Assembly - Remove
b - Control Valve Assembly - Remove
c - Flow Control Spring - Remove
d - Studs - Remove
e - Reservoir - Tap from Pump Housing
f - O-rings - Remove and Discard

4. Remove retaining ring and end plate.

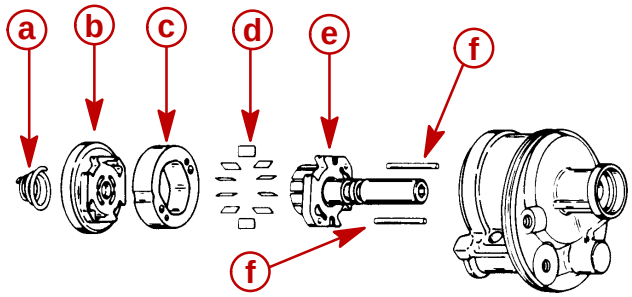


22150

a - Retaining Ring - Position so that Ring End is 1 in. (25 mm) from End of Hole in Housing
b - Hole - Insert into Awl in Housing to Push Ring from Recess
c - Screwdriver - Pry Ring from Pump Body

Index

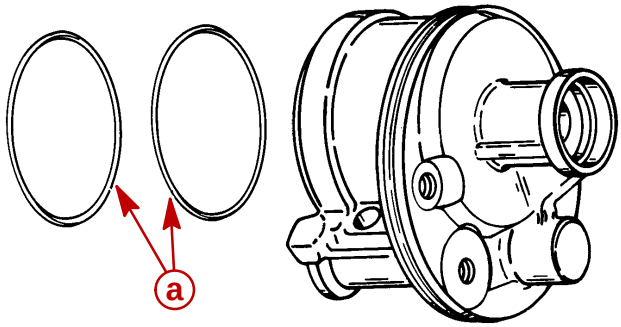
5. Remove pump components shown.



22155

a - Spring
b - Pressure Plate
c - Pump Ring
d - Pump Vanes
e - Pump Shaft and Rotor Assembly
f - Dowel Pins

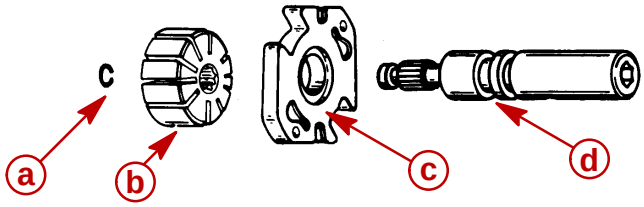
6. Remove and discard O-rings from housing.



22155

a - O-rings - Discard

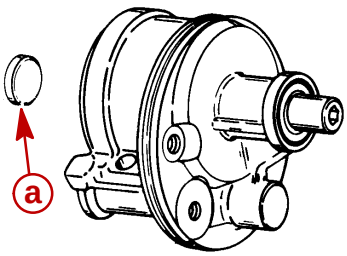
7. Remove rotor and thrust plate.



22155

a - Retaining Ring - Remove
b - Rotor
c - Thrust Plate
d - Pump Shaft

8. Remove magnet.



22154

a - Magnet

Index

Cleaning And Inspection

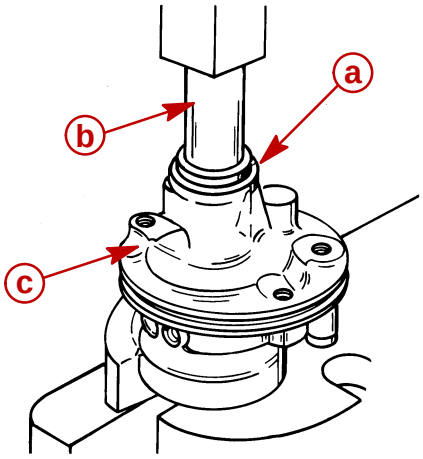
1. Clean and inspect all metal parts.

Reassembly

NOTE: *All references to Power Steering fluid refer to Quicksilver Power Trim and Steering Fluid, or Dexron II if Quicksilver product is not available.*

NOTE: *Obtain and install a new seal kit 5688044 from a local GM automotive dealer when reassembling pump.*

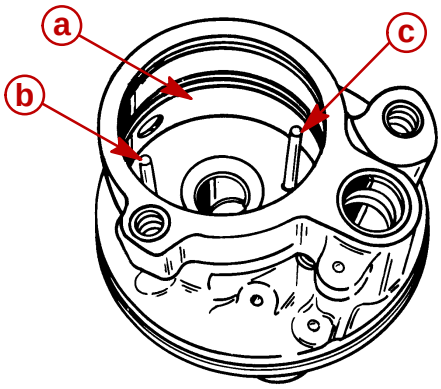
1. Install new pump shaft oil seal.



22151

a - New Oil Seal - Metal Side Up
b - 1 in. Socket
c - Pump Reservoir - Properly Support so Reservoir Back Does Not Distort

2. Install pressure plate O-ring and dowel pins.



22150

a - Pressure Plate O-ring - Lubricate with Power Steering Fluid; Place in Third Groove in Housing
b - Dowel Pins

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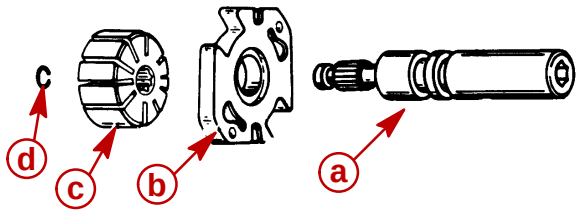
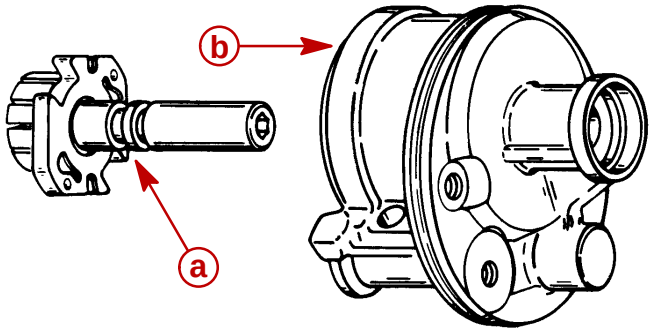
3. Assemble pump shaft and rotor assembly.



22155

a - Pump Shaft
b - Thrust Plate
c - Rotor - Countersunk Side Toward Thrust Plate
d - Retaining Ring

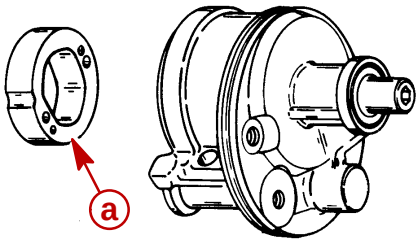
4. Install pump shaft and rotor assembly.



22154

a - Pump Shaft and Rotor Assembly
b - Pump Housing

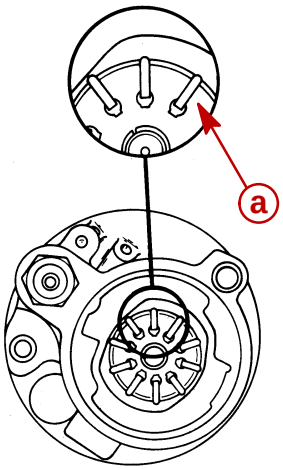
5. Install pump ring.



22154

a - Pump Ring - Place 2 Smaller Holes Over Dowel Pins

6. Install vanes in rotor slots - Rounded edges toward pump ring. Vanes must slide freely.

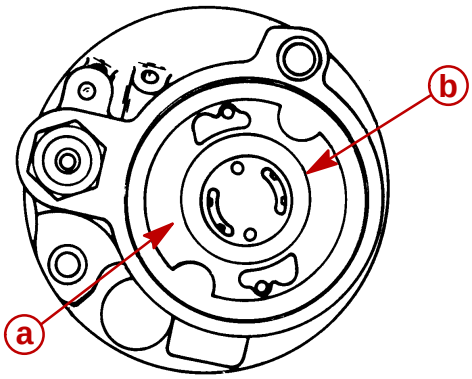


22154

a - Vanes - Rounded Edges Toward Pump Ring

Index

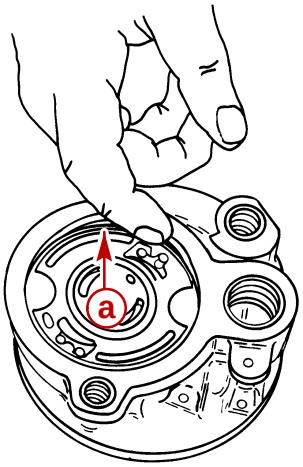
7. Install pressure plate.



22154

a - Pressure Plate
b - Spring Groove - Facing Up

8. Install end plate O-ring.

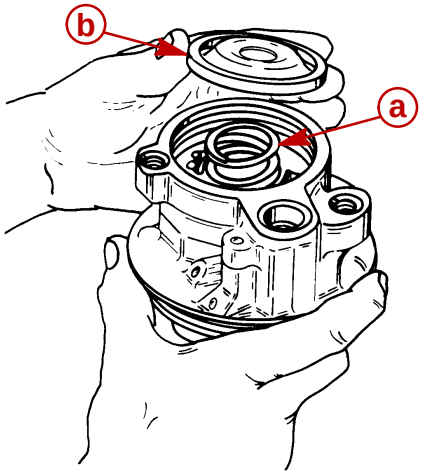


22150

a - End Plate O-ring - Lubricate with Power Steering Fluid; Place in Second Groove in Housing

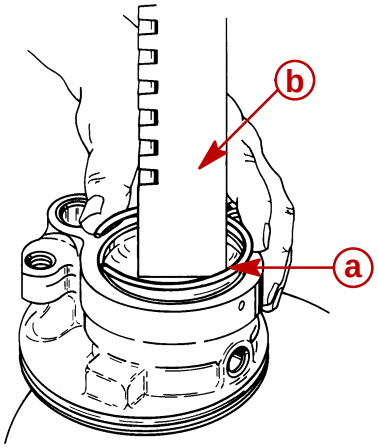
Index

9. Install pressure plate spring, end plate and retaining ring.



22151

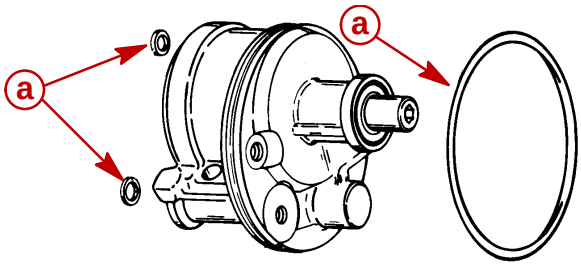
a - Pressure Plate Spring
b - End Plate



22152

a - Retaining Ring
b - Arbor Press - Use Care Not to Damage End Plate O-ring

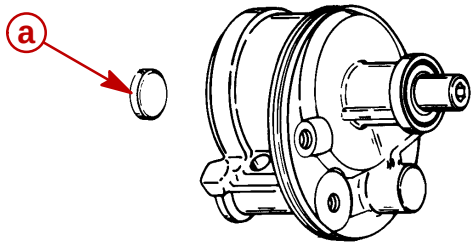
10. Install reservoir O-rings.



22153

a - Reservoir O-ring - Lubricate with Power Steering Fluid; Install in Groove in Pump Housing

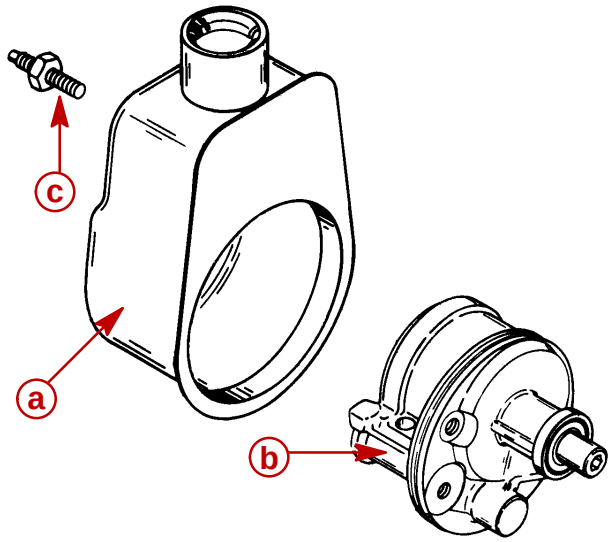
11. Place magnet on housing.



22153

a - Magnet

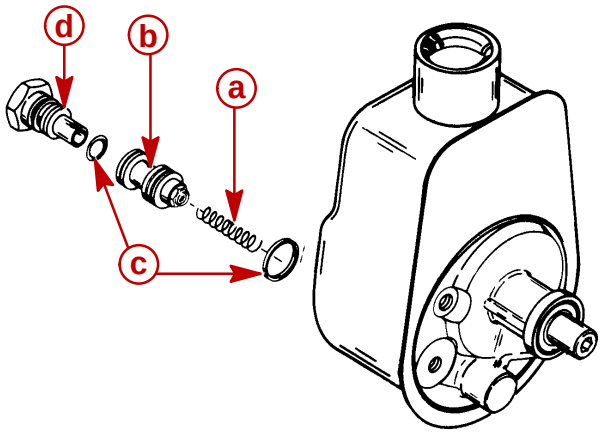
12. Secure reservoir to pump housing.



22153

a - Reservoir
b - Pump Housing
c - Studs - Torque to 35 lb. ft. (47 N·m)

13. Install components shown.



22153

a - Flow Control Spring
b - Control Valve Assembly
c - O-ring - for Fitting Assembly
d - Fitting Assembly - Torque to 35 lb. ft. (47 N·m)

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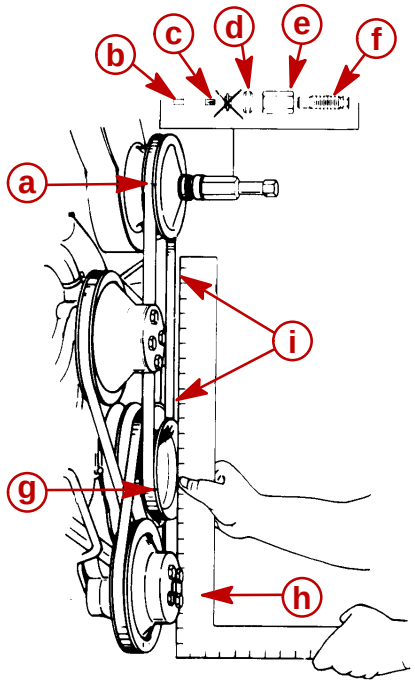
14. Install pulley, as follows, using Pulley Pusher Assembly 91-93656A1, and a long straight edge:
    a. Place pulley on pump shaft.
    b. Thread stud ALL-THE-WAY into pump shaft. Place bearing over stud. DO NOT use spacer from kit.
    c. Thread nut onto shaft. Thread shaft (and nut) ALL-THE-WAY onto stud.
    d. Using a long straight edge (to check drive belt alignment), turn large pusher nut until drive belt is parallel to straight edge.
    e. Check pulley installation for correct alignment.



a - Power Steering Pump Pulley
b - Stud
c - DO NOT Use Spacer
d - Bearing
e - Nut
f - Shaft
g - Crankshaft Pulley (Shown) or Water Circulating Pump Pulley
h - Long Straight Edge
i - Drive Belt Parallel

15. Install power steering pump on engine. (Refer to appropriate Engine Service Manual.)

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Multiple Sterndrive Steering Tie Bar Arrangements

With multiple sterndrives it is important to consider which of several possible steering systems should be selected.

⚠ CAUTION

Failure to observe the recommended Tie Bar Arrangements as presented in this section could result in serious damage to the steering and/or trim system components. This damage could adversely affect control of the boat.

INTERNAL TIE BAR ONLY

At the lower end of the performance spectrum (boats not capable of speeds in excess of 60 MPH) the basic internal tie bar is recommended. It connects the slave sterndrive to the sterndrive that is directly connected to the factory power steering output. This internal tie bar is available in a variety of lengths from the sterndrive manufacturer.

INTERNAL AND EXTERNAL TIE BAR

As a boat moves into a moderate performance range (60-70 MPH) or for a reduction in steering backlash, an external tie bar should be added. External tie bars are usually designed to attach at the aft power trim cylinder bosses which is an excellent location because of its proximity to the propeller. HOWEVER, because of the potential overstress that can occur if one drive is trimmed much differently than the other, a dual trim control kit (Part Number 90362A3) should be installed so as to limit this potential tilt differential to about 20°.

EXTERNAL POWER STEERING

When boat speeds move past 70 MPH or if additional steering backlash reduction is desired, external power steering is recommended. This normally will include an external tie bar mounted at the same general location of the power steering cylinders which are generally attached at the top of the sterndrive's drive shaft housing. With this steering system, no internal tie bar should be used. These steering cylinders can be attached either inboard (between) or outboard of the sterndrives.

EXTERNAL POWER STEERING WITH LOW EXTERNAL TIE BAR

For the fastest boats (over 80 MPH) or for the ultimate in steering backlash reduction, use external power steering, BUT (where mechanically possible) with the external tie bar mounted at the trim cylinder boss location (as previously described in "Internal and External Tie Bar" statements). Again this system does not use an internal tie bar.

Mercury Marine does not recommend the use of an external tie bar ONLY (no internal tie bar) when using the internal power steering system. This can cause excessive loads on the steering components on the drive connected to the internal power steering system. These increased loads can damage the steering components, resulting in increased play in the steering of the boat.

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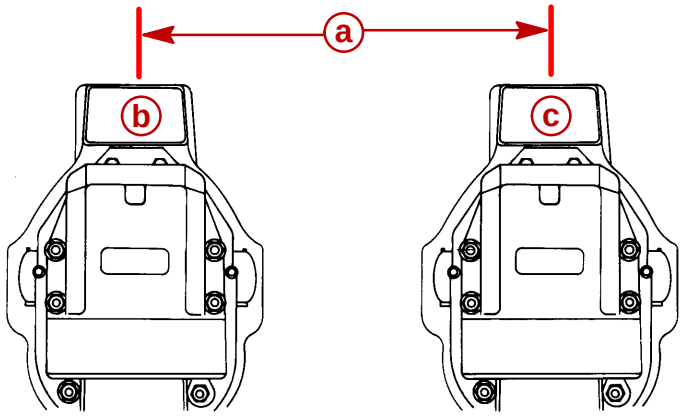
Determining Tie Bar Length

⚠ WARNING

ON DUAL INSTALLATION USING STARBOARD TIE BAR KIT. The steering cable MUST have a minimum radius of 8 in. (203 mm) at the transom end. A radius less than 8 in. (203 mm) may kink the steering cable which, in turn, may affect steering operation. If the minimum 8 in. (203 mm) requirement cannot be met due to boat construction, etc., steering cable must then be routed to port transom and a port transom and a port tie bar kit 96708A4, A5 or A6 MUST BE used in place of the starboard tie bar kit.

NOTE: *If drive units are to be "toed-in" or "toed-out," measure from centerlines of steering levers (with drive units positioned as desired), instead of centerlines of power packages. In most cases, the best boat handling and performance characteristics will be obtained with the drive units positioned parallel.*

1. Determine tie bar length.
   a. Measure centerline distance (Dimple in Gimbal Housing is located beneath the decal in the top center).
   b. Apply measurement to appropriate chart to determine tie bar length.



70133

a - Distance Between Centerlines
b - Port Transom Assembly Centerline
c - Starboard Transom Assembly Centerline

Selection

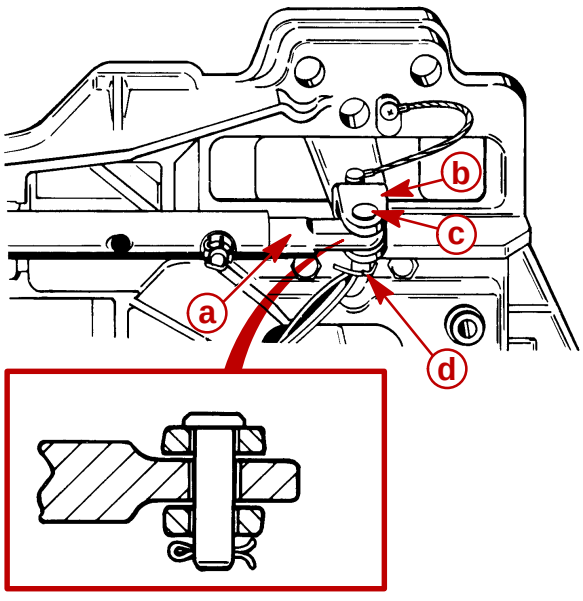
TIE BAR CHART For Dual Installations with Steering Cable Attached to Starboard Power Package	
* 16” to 30”	92020A1
* 30” to 46”	92020A2
46” to 62”	92020A3
* If centerline distance is the same as maximum figure, use next larger size tie bar.	

TIE BAR CHART For Dual Installations with Steering Cable Attached to Port Power Package	
* 28” to 37-1/2”	96708A4
* 37-1/2” to 55”	96708A5
55” to 72”	96708A6
* If centerline distance is the same as maximum figure, use next larger size tie bar.	

Installation

DUAL INSTALLATIONS WITH STEERING CABLE ATTACHED TO STARBOARD POWER PACKAGE

1. Install tie bar.
   a. Attach fixed bar end to steering lever, using clevis pin and cotter pin. Spread cotter pin ends.



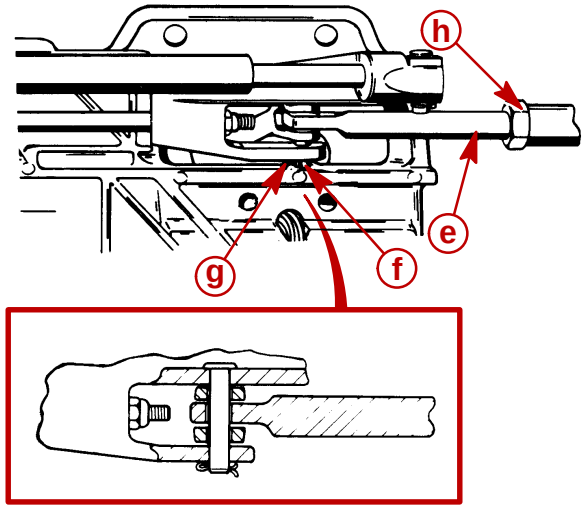
22079

22211

a - Adjustable End
b - Steering Lever
c - Clevis Pin
d - Cotter Pin

Index

b. Position drive units as desired and turn adjustable end out (if necessary) to align hole in bar end with holes in steering lever and piston rod end clevis. Turn adjustable end out 3 to 4 turns from this position. Apply Loctite 8831, Type “A,” or equivalent, to exposed tie bar threads; then turn tie bar back in (3 to 4 turns) to previously aligned position. Attach tie bar end using clevis pin (f), and cotter pin (g). Spread cotter pin ends. Apply Loctite 8831, Type “A,” or equivalent, to exposed tie bar threads, then, tighten locknut (against tie bar) to 40-60 lb. ft. (54-81 N·m).



22079

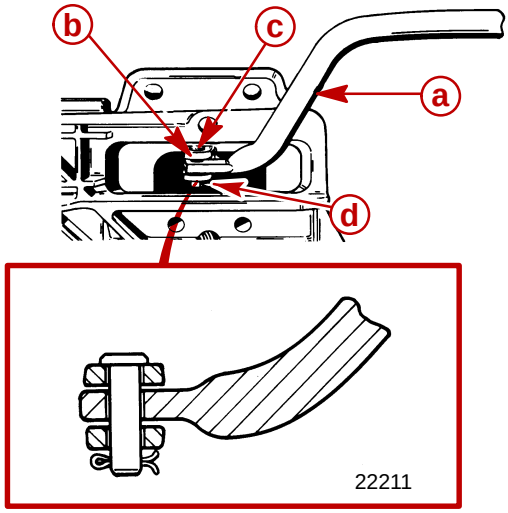
22211

e - Adjustable End
f - Clevis Pin
g - Cotter Pin
h - Locknut

DUAL INSTALLATIONS WITH STEERING CABLE ATTACHED TO PORT POWER PACKAGE

1. Install tie bar.

a. Attach fixed bar end to steering lever, using clevis pin and cotter pin. Spread cotter pin ends.

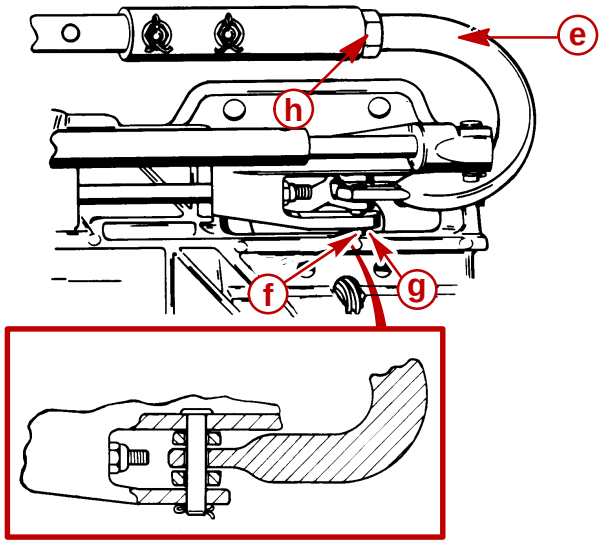


22079

a - Fixed Bar End
b - Steering Lever
c - Clevis Pin
d - Cotter Pin

Index

b. Position drive units as desired and turn adjustable end out (if necessary) to align hole in bar end with holes in steering lever and piston rod end clevis. Turn adjustable end out 3 to 4 turns from this position. Apply Loctite 8831, Type “A,” or equivalent, to exposed tie bar threads; then turn tie bar back in (3 to 4 turns) to previously aligned position. Attach tie bar end using clevis pin, and cotter pin. Spread cotter pin ends. Apply Loctite 8831, Type “A,” or equivalent, to exposed tie bar threads, then, tighten locknut (against tie bar) to 40-60 lb. ft. (54-81 N·m).



22079

22211

e - Adjustable End
f - Clevis Pin
g - Cotter Pin
h - Locknut

CORROSION PROTECTION

Section 7A - All Models

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7 A

Specifications

Special Tools

DESCRIPTION	PART NUMBER
MerCathode Reference Electrode Test	76675A1
Quicksilver VOA Meter*	91-62562A1

*If you do not already have this meter, use a digital multi-meter (such as a Radio Shack 22-191). DO NOT use a standard analog (Needle-Type) Meter as inaccurate readings will result.

IMPORTANT: Quicksilver Volt/Ohm Meter 91-93572 and Multi-Meter DVA/Tester 91-99750 are no longer recommended for testing corrosion protection.

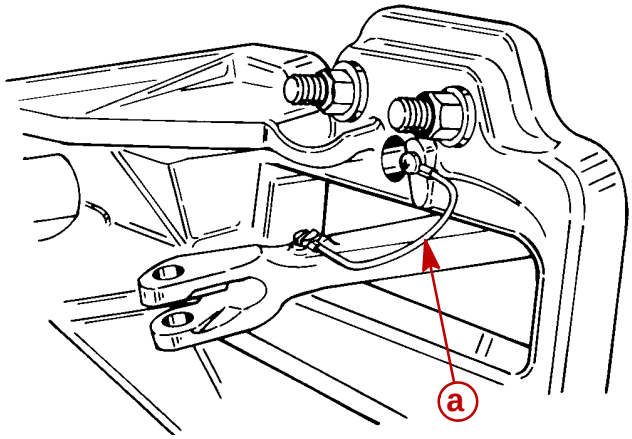
Lubricants/Sealers/Adhesives

DESCRIPTION	PART NUMBER
Quicksilver Liquid Neoprene	92-25711-2

Continuity Circuit

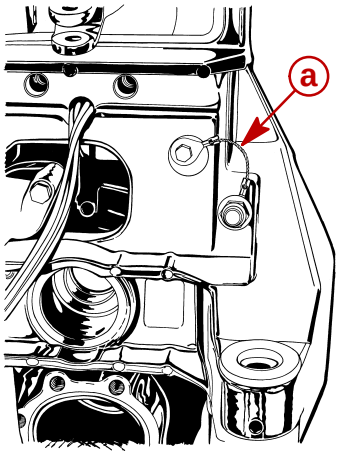
Transom assembly and sterndrive unit are equipped with ground circuit wires to ensure good electrical continuity between engine, transom assembly, and sterndrive components. Good continuity is essential for the zinc trim tab and MerCathode System to function most effectively.

Inspect the following ground circuit components, at intervals (Section 1B), for loose connections, broken or fraying wires.

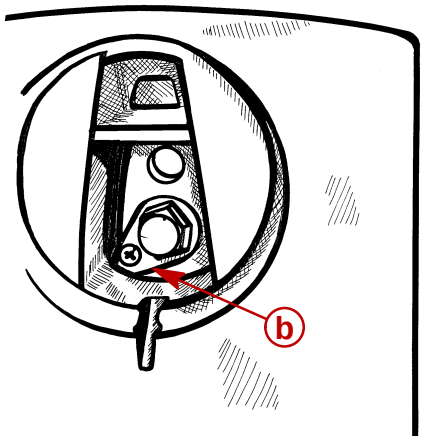


22028

a - Steering Lever Ground Wire

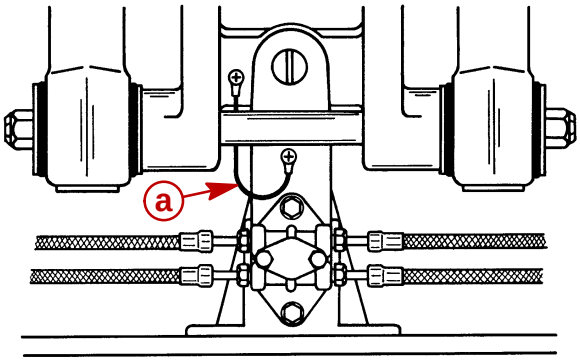


22650



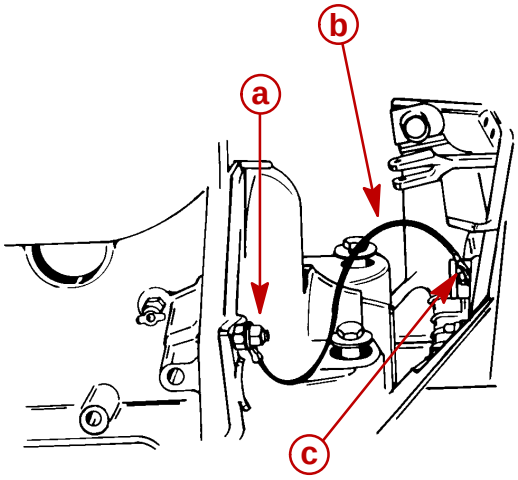
22754

a - Inner Transom Plate to Gimbal Housing Ground Wire
b - Driveshaft Housing to Gear Housing Ground Plate (Inside Trim Tab Cavity)



22230

a - Gimbal Housing to Gimbal Ring Ground Wire



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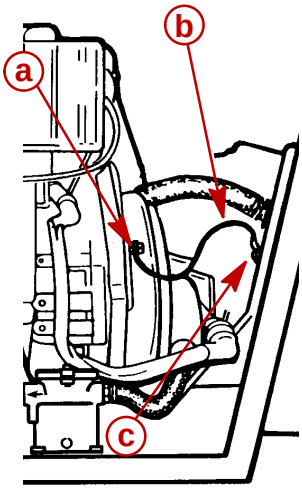

50242

Gasoline Models **Diesel Models**

a - Flywheel Housing Grounding Stud
b - Ground Wire
c - Inner Transom Plate Grounding Screw - DO NOT Ground ANY Accessory at this connection

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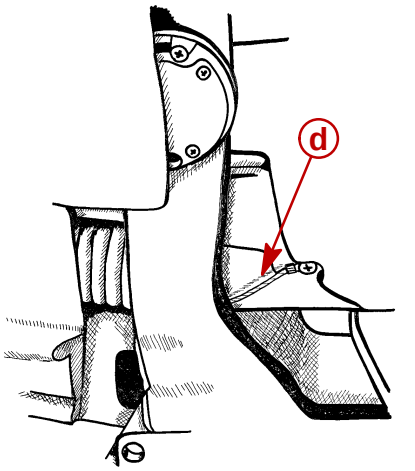
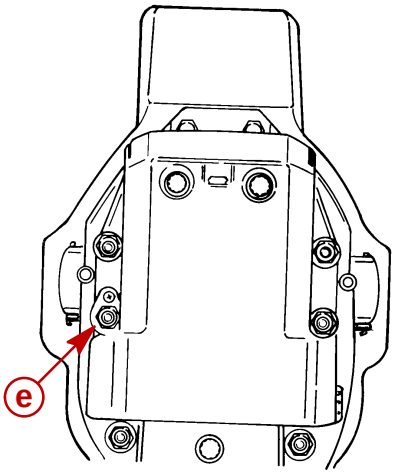
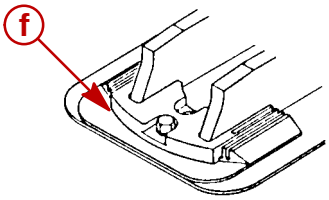


22755

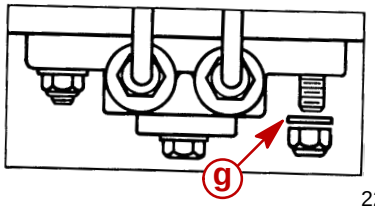


22031

d - Gimbal Ring to Bell Housing Ground Wire
e - Drive Unit to Bell Housing Ground Plate

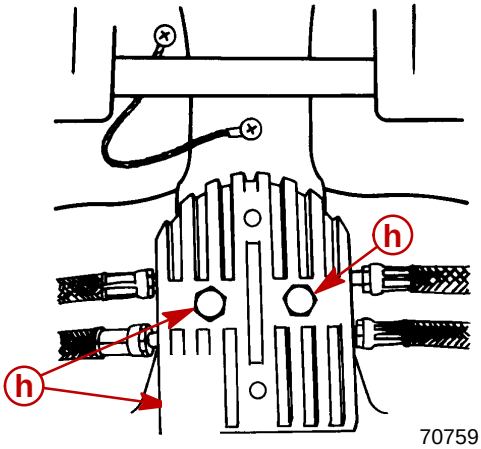


70575



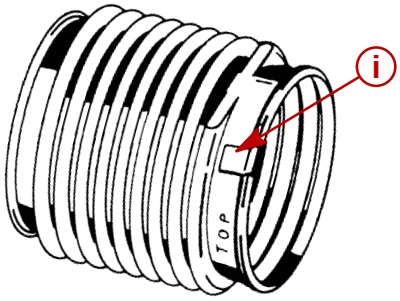
22230

f - Driveshaft Housing to Gear Housing Anodic Plate
g - Hydraulic Connector Block to Gimbal Housing Ground Washer

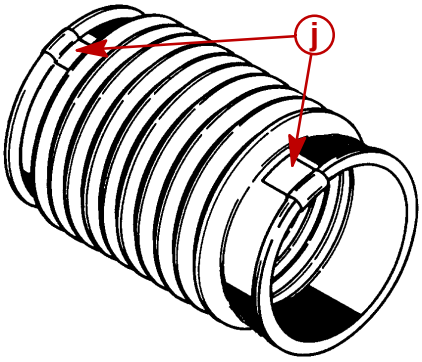


70759

h - Anodic Block to Hydraulic Manifold and Ground Washers (Beneath Screws).



50383



22079

i - U-joint Bellows Ground Clip
j - Exhaust Bellows Ground Clips

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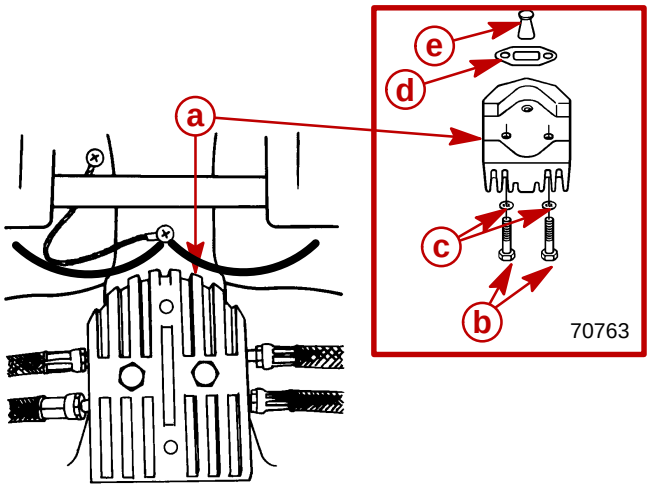
Anodic Block

⚠ CAUTION

DO NOT paint new anodic block as this will render it ineffective as a galvanic corrosion inhibitor.

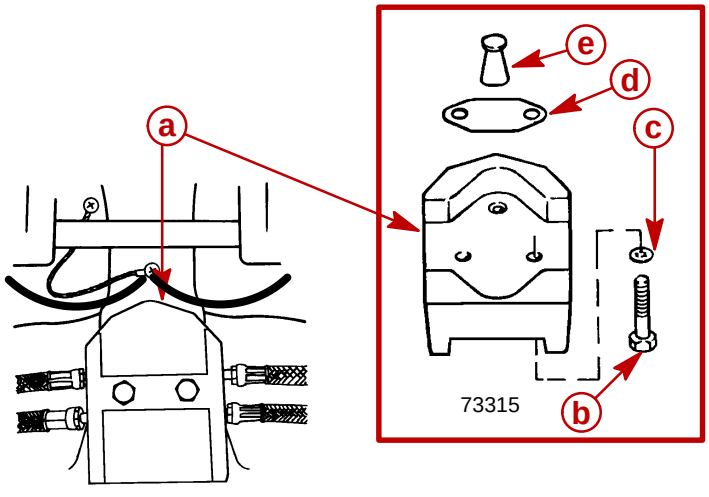
1. Remove screws, ground washers and gasket from anodic block. Remove anodic block to hydraulic manifold gasket and discard.



70759

Earlier Style Anodic Block

a - Anodic Block
b - Screws
c - Continuity Washers
d - Gasket
e - Seal



73892

Later Style Anodic Block

a - Anodic Block
b - Screw
c - Continuity Washer
d - Gasket
e - Seal

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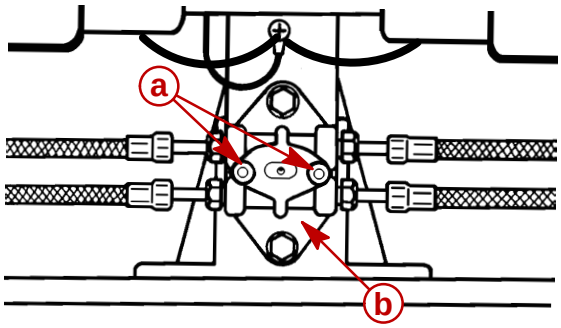
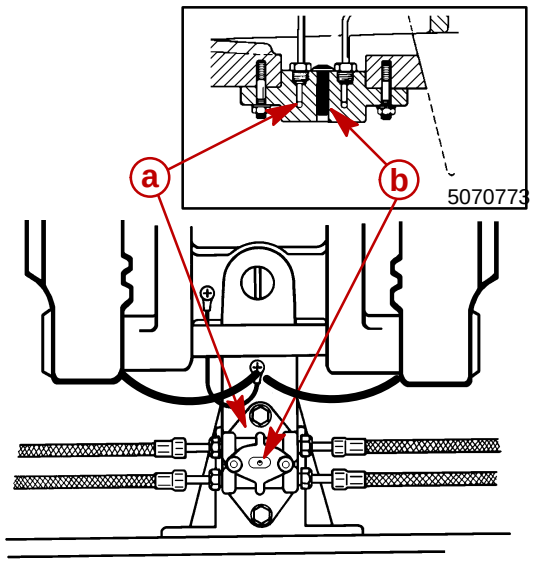
2. Check condition of hydraulic manifold and clean any debris from threaded holes.



70748

a - Screw Holes
b - Hydraulic Manifold

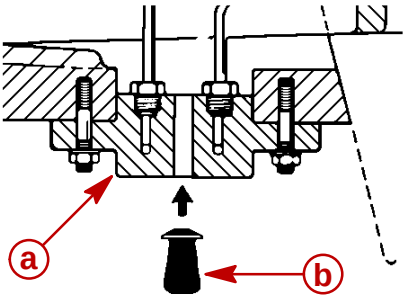
3. Examine rubber seal inside of hydraulic manifold block for signs of leakage or wear. Replace if necessary.



70748

a - Hydraulic Manifold
b - Rubber Seal

4. If rubber seal needs replacement, push old seal out of hydraulic manifold and install new seal as shown.



70774

a - Hydraulic Manifold
b - Rubber Seal

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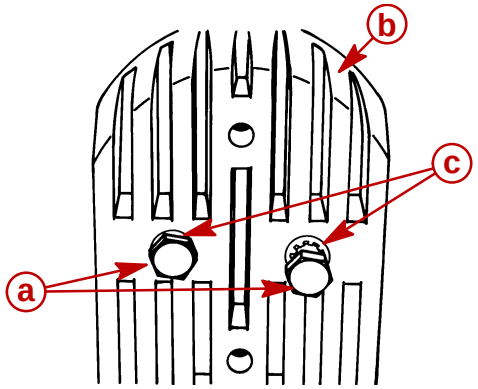
5. Install screws and washers into block as shown.



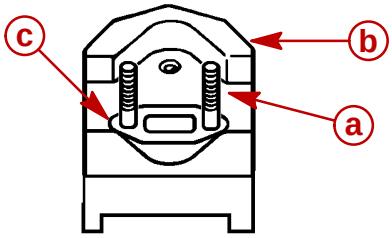
70760

a - Screws (2)
b - Anodic Block
c - Continuity Washers (2)

⚠ CAUTION

To be effective, new anodic block MUST make good continuity contact with gimbal housing.

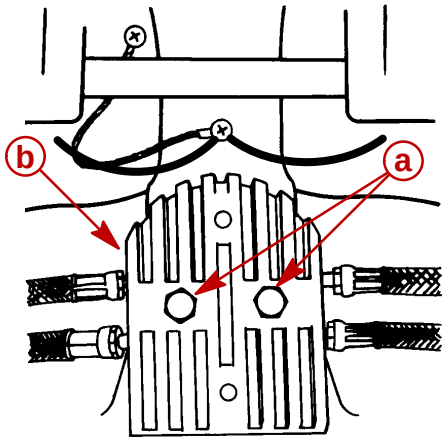
6. Be sure new gasket is in proper position between anodic block and hydraulic manifold. Apply Quicksilver Perfect Seal (P/N 92-34227-1) to threads of screw once they are through block.



70772

a - Screws (2)
b - Anodic Block
c - Gasket

7. Snug both screws evenly into hydraulic manifold, then torque to 80-120 lb. in. (9-14 N•m).



70759

a - Screws and Washers
b - Anodic Block

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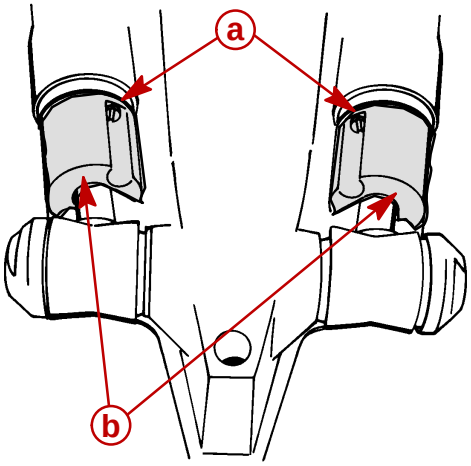
Trim Cylinder Anodes

⚠ CAUTION

DO NOT paint new trim cylinder anodes, as this will render them ineffective as a galvanic corrosion inhibitor.

1. Remove screws that secure anodes to trim cylinders. Remove anodes.



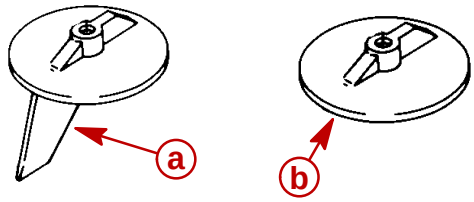
71966

a - Screws
b - Trim Cylinder Anodes

2. Scrape mounting surface on cylinder end-cap down to bare metal.
3. Install new anodes and tighten securely.

Anodic Trim Tab or Plate

NOTE: *Later models are equipped with an anodic plate instead of trim tab. Replacement procedure is the same.*



75251

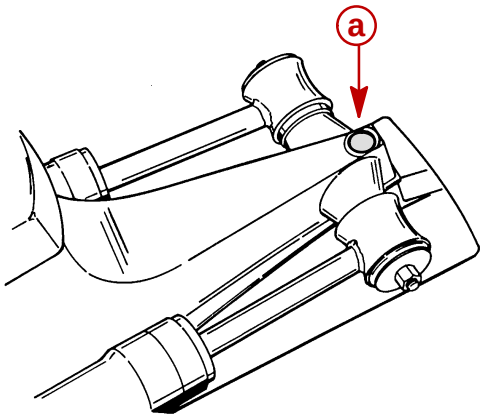
a - Trim Tab
b - Anodic Plate

⚠ CAUTION

DO NOT paint new trim tab (or anodic plate), as this will render it ineffective as a galvanic corrosion inhibitor.

Bravo One Drive Units

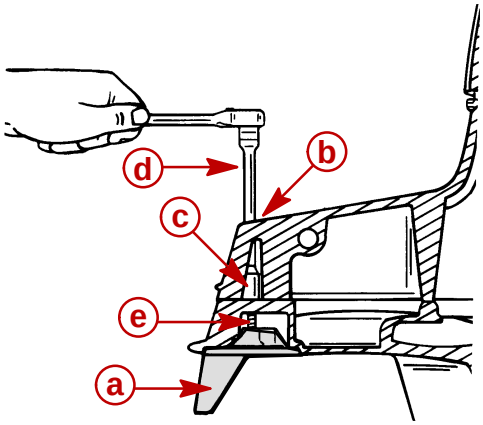
1. Remove plug from driveshaft housing to gain access to attaching screw.



22093

a - Plug

2. Use a 1/2 in. standard socket and extension, loosen screw, and remove trim tab (or anodic plate).



22258

a - Trim Tab (Or Anodic Plate, Depending Upon Model)
b - Plug - (Removed)
c - 1/2 in. Socket
d - Extension
e - Screw

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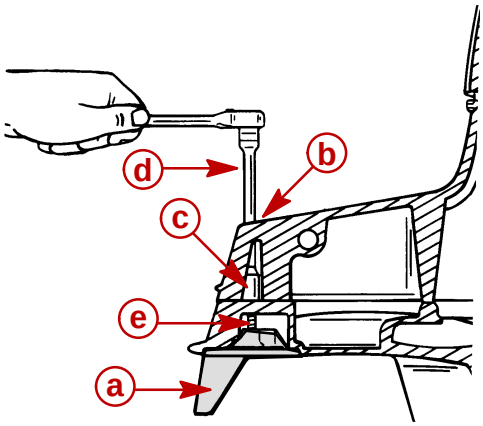
⚠ CAUTION

To be effective, new trim tab (or anodic plate) MUST make good electrical contact with gear housing.

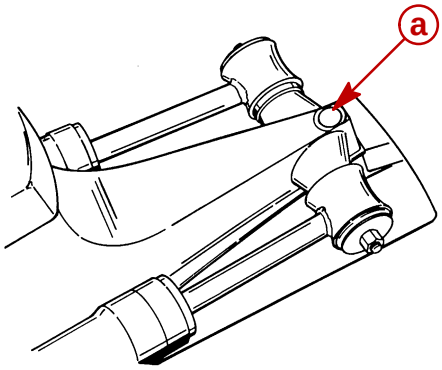
3. Scrape trim tab (or anodic plate) mounting surface on gear housing down to bare metal.
4. Install trim tab and align straight back. Torque screw to 25-35 lb. ft. (34-47 N•m).



22258

a - Trim Tab (Or Anodic Plate, Depending Upon Model)
b - Plug - (Removed)
c - 1/2 in. Socket
d - Extension
e - Screw

5. Reinstall plug in driveshaft housing.

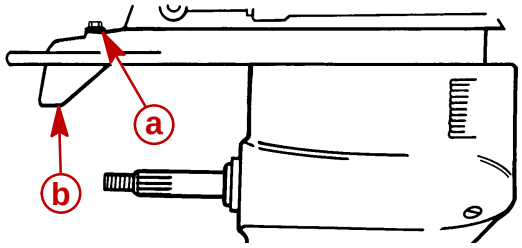


22093

a - Plug

Bravo Two Drive Units

1. Use a 1/2 in. standard socket to loosen screw and remove trim tab.
2. Scrape trim tab mounting surface down to bare metal to insure continuity.
3. Install trim tab and align straight back. Torque screw to 25-35 lb. ft. (34-47 N•m).

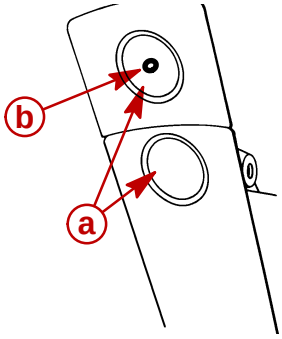


50323

a - Screw [Torque to 25-35 lb. ft. (34-47 N•m)]
b - Trim Tab (Position Straight Back)

Bravo Three Drive Units

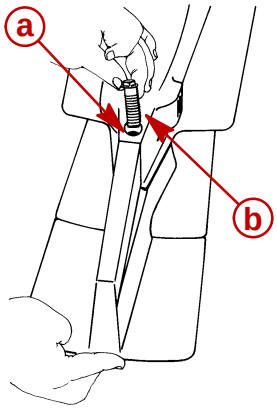
NOTE: *Earlier Bravo Three drive units were equipped with two anodic plates. The rear anode is attached with a bolt from the bottom side of the splash plate.*



72029

a - Anodic Plates
b - Screw (Attaches From Bottom Side)

1. Remove plastic cap to gain access to the anode (front) attaching bolt.



71804

a - Plastic Cap (Removed)
b - Bolt

2. Scrape the mounting surface on gear housing down to bare metal to insure continuity.
3. Install new anode(s). Torque to 23 lb. ft. (32 N•m).
4. Reinstall plastic cap.

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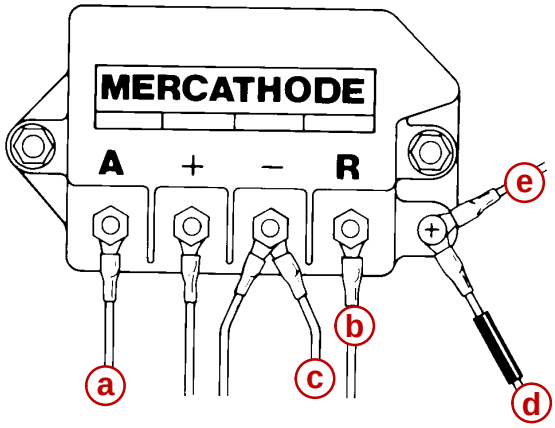
Integral MerCathode System

Removing Electrode Assembly

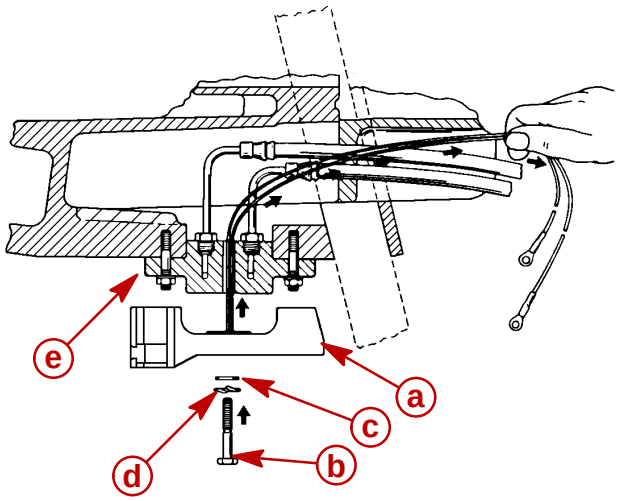
1. Disconnect electrode assembly wires from MerCathode Controller.



22032

a - Electrode Assembly Wire (Orange)
b - Electrode Assembly Wire (Brown)
c - Earlier Models - Trim Position Sender Wire (Black)
d - Earlier Models - Trim Position Sender Wire (Black)
e - Earlier Models - Wire to Trim Position Gauge (Brown/White)

2. Remove two screws, flat washers and lock washers; then remove electrode assembly.



70771

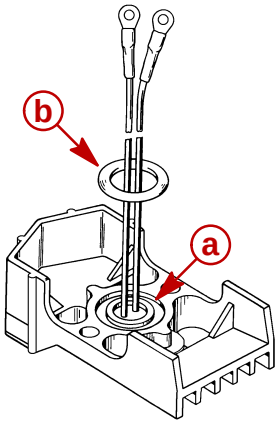
a - Electrode Assembly
b - Screw (2)
c - Flat Washer (2)
d - Lock Washer (2)
e - Hydraulic Connector Block

Installing Electrode Assembly

⚠ CAUTION

O-ring MUST BE properly seated in groove of electrode assembly or water leakage into boat will result.

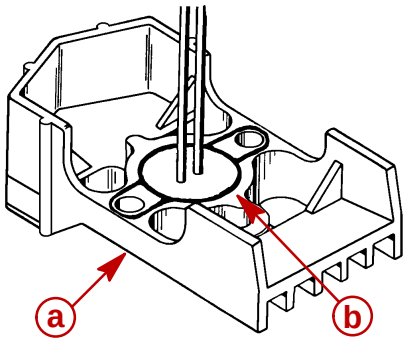
1. **Earlier Model Electrodes:** Install the O-ring over the orange and brown wires from the electrode assembly. Seat the O-ring in the groove. DO NOT use any type of sealer on the O-ring.



70756

a - O-ring Groove
b - O-ring

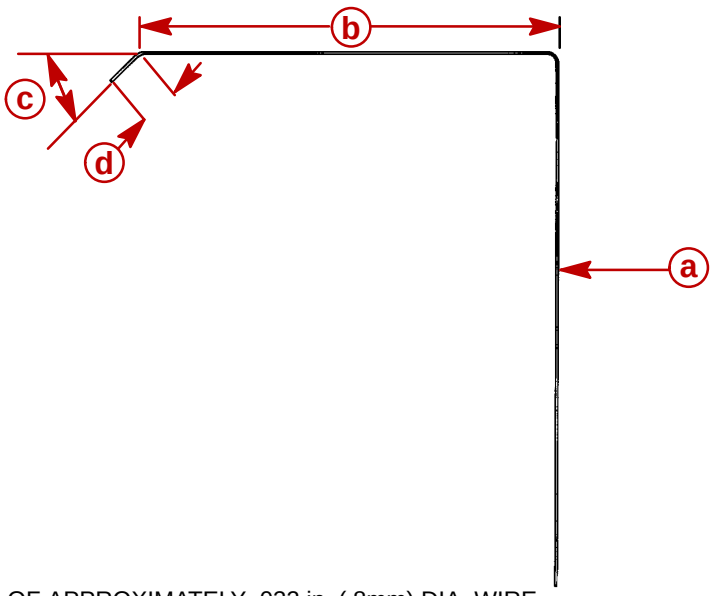
2. **Later Model Electrodes:** Later model electrodes have a factory installed rubber grommet and DO NOT require an O-ring.



71862

a - Electrode
b - Rubber Grommet

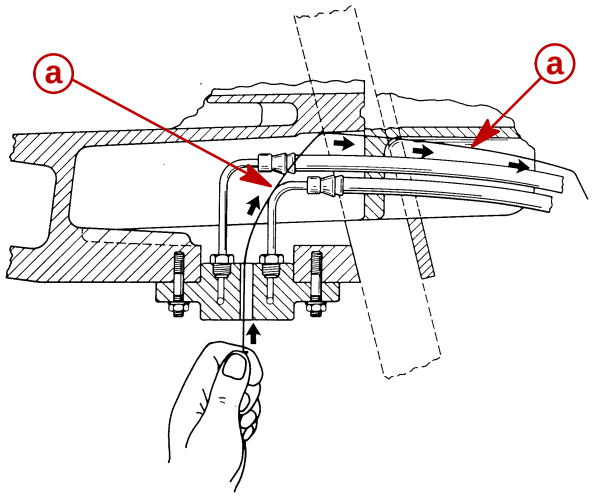
3. Form a 2 ft. (610mm) long piece of approximately .032 in. diameter wire to the dimensions shown.



74106

a - 2 ft. (610mm) OF APPROXIMATELY .032 in. (.8mm) DIA. WIRE
b - 5 in. (123 mm)
c - 45° Angle
d - 1/2 in. (13 mm)

4. Insert 45° angle end of wire through center hole in hydraulic connector block.
5. Guide wire through hole until wire protrudes through cavity on the bottom of exhaust pipe.



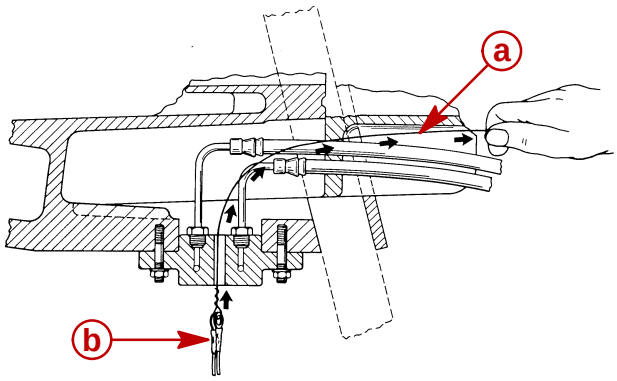
22235

a - Wire

6. Secure ring terminals to tracer wire.
7. Guide leads through center hole in connector block.

IMPORTANT: Orange lead is approximately 6 in. (150mm) longer than the brown lead.

8. Pull leads ALL the way into the boat.



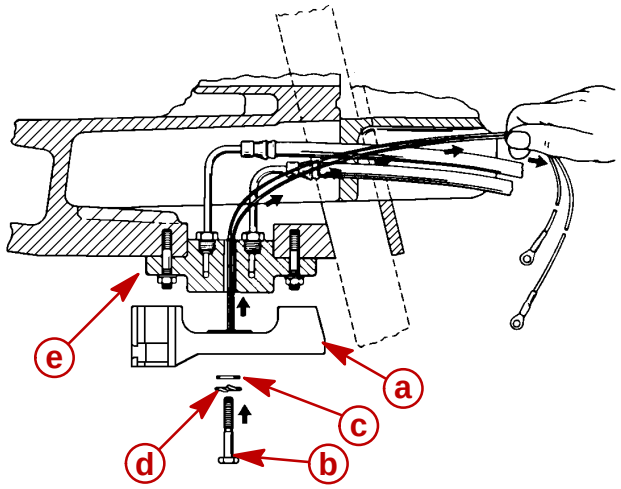
22234

a - Wire
b - Leads

⚠ CAUTION

DO NOT paint sacrificial anodes or MerCathode System electrode assembly, as this will render them ineffective as galvanic corrosion inhibitors.

9. Position and secure electrode assembly to gimbal housing using two 1-3/8 in. (35mm) long screws, flat washers and lockwashers. Torque to 20-30 lb. in. (2.2-3.3 N•m). DO NOT OVERTIGHTEN.



70771

a - Electrode Assembly
b - Screw (2)
c - Flat Washer (2)
d - Lock Washer (2)
e - Hydraulic Connector Block

Connect Electrical Leads to Controller Assembly

NOTE: *If black (ground) wire is not available at terminal block or from wire harness, install a separate lead between controller negative (–) terminal and negative (–) battery cable attaching point on engine.*

1. Connect electrical leads to controller assembly, securely. (See applicable Wiring Diagrams, following.)
2. Apply a thin coat of Quicksilver Liquid Neoprene (92-25711) to ALL electrical connections.

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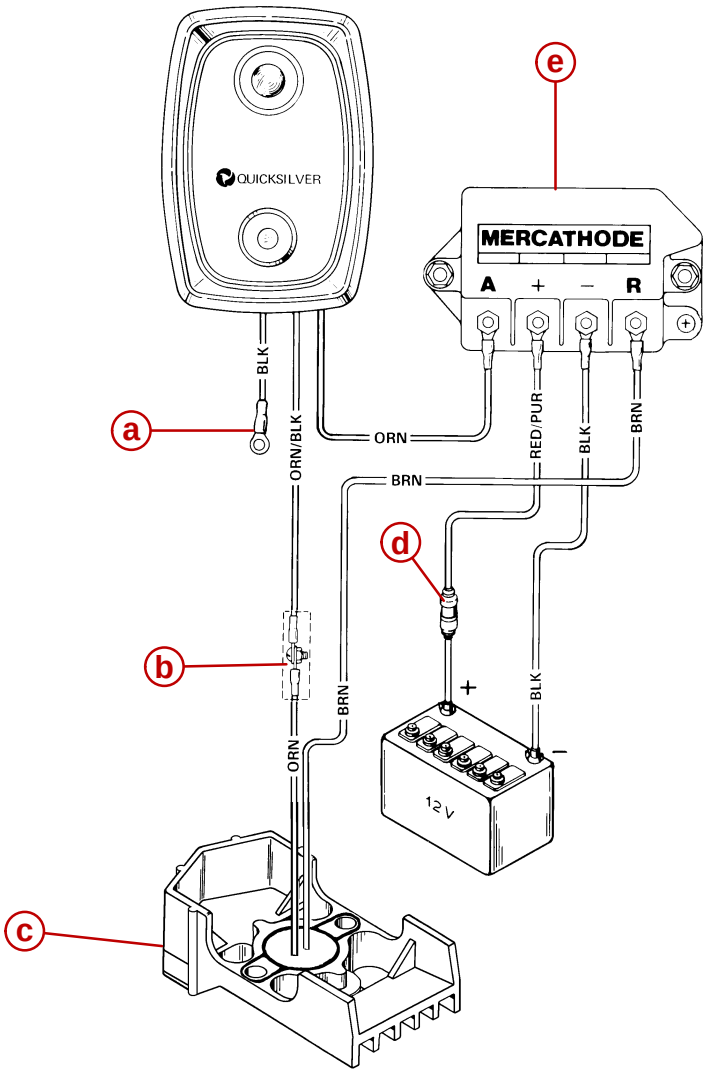
Wiring Diagrams

MerCathode Monitor

BLK = Black
BLU = Blue
BRN = Brown
GRY = Gray
GRN = Green
ORN = Orange
PNK = Pink
PUR = Purple
RED = Red
TAN = Tan
WHT= White
YEL = Yellow
LIT = Light
DRK = Dark



74251

a - Ground to a Suitable Ground on the Instrument Panel
b - Screw, Nut and Sleeve
c - Electrode
d - 20 Amp Fuse
e - Controller

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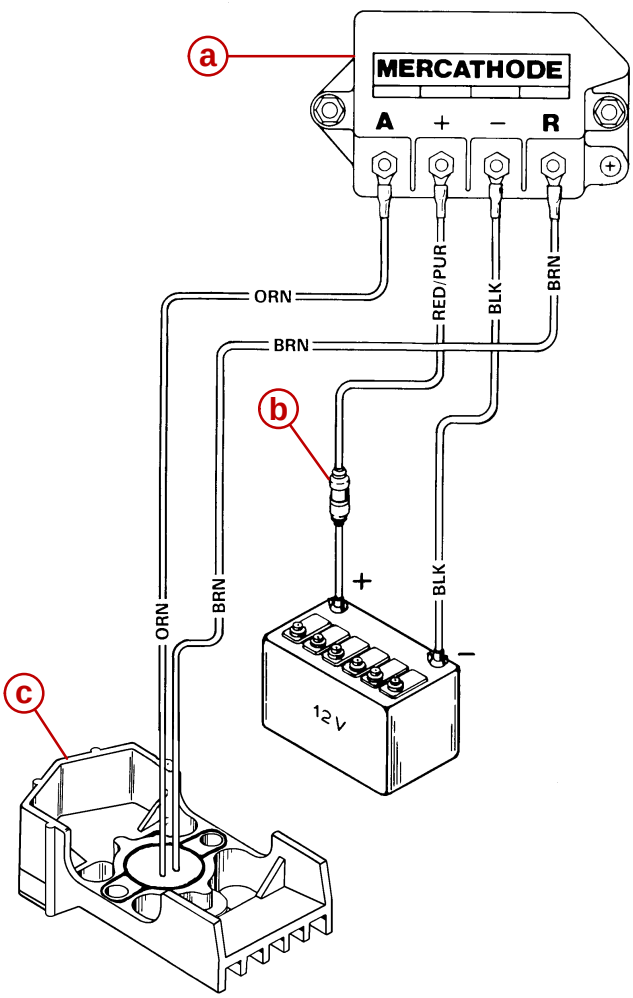
MerCathode Controller



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73596

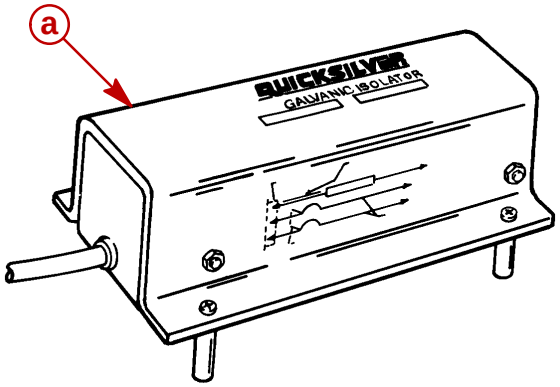
a - Controller
b - 20 Amp Fuse
c - Electrode

Quicksilver Isolator

Boats, which are connected to A.C. shore power require additional protection, to prevent destructive low voltage galvanic currents from passing thru the shore power ground wire. A Quicksilver Isolator (7664A3) can be installed to block the passage of these currents, while still providing a path to ground for dangerous fault (shock) currents.

⚠ CAUTION

If A.C. shore power is not isolated from boat ground, the MerCathode System and sacrificial anodes may be unable to handle the increased galvanic corrosion potential.



70972

a - Quicksilver Isolator

Corrosion Protection Testing and Troubleshooting

NOTE: *The following corrosion protection test supersedes all previously issued tests. This test can be used on applications with or without a MerCathode System.*

Use the following test to determine if drive unit is being afforded adequate corrosion protection, or if additional corrosion protection is required. If the unit is equipped with a MerCathode System, it is recommended that this test be performed at least once each year, where the boat is moored, to ensure that the system is functioning properly.

Test requires the us of MerCathode Reference Electrode Test 76675A1, and Quicksilver VOA meter 91-62562A1. This meter is no longer available from Mercury Marine. If you do not already have this meter, a digital multi-meter (such as a Radio Shack 22-191) must be used. A STANDARD ANALOG (Needle-Type) METER CANNOT BE USED, AS AN INACCURATE READING WILL RESULT.

IMPORTANT: Quicksilver Volt/Ohm Meter 91-93572, and Multi-Meter DVA/Tester 91-99750, are no longer recommended for testing corrosion protection.

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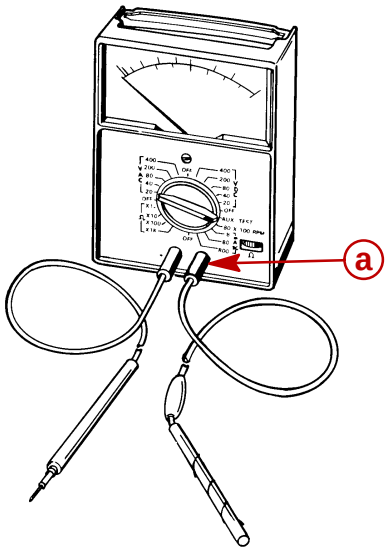
The MerCathode Reference Electrode Tester 76675A1 is equipped with a special jack (containing a resistor to provide the proper scale reading when used with Quicksilver VOA Meter 91-6256A1. Previously, we stated that this plug could be removed to allow tester to be used with other analog type meters. Further testing has revealed that this could result in inaccurate readings and, therefore, **we no longer recommend the removal of this plug, and the use of other analog meters.** Resistor jack can be left in place when using digital meters.



22465

Quicksilver VOA Meter 91-62562A1 and MerCathode Reference Tester 76675A1

a - Special Resistor Jack

NOTE: *Set-up test equipment as shown on page 7A-21.*

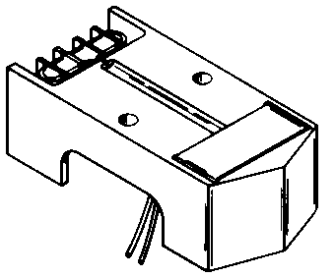
IMPORTANT: Be sure to observe the following when performing test:

- **If equipped with MerCathode System, ensure battery is fully charged (12.6 Volts or above).**
- **New boats just placed in service usually will produce a reading higher than normal. This is due to the drive unit being protected by a good finish and new sacrificial anodes. To obtain an accurate diagnosis, the test should be performed after the boat has been in service at least one or two weeks. This will give the paint a chance to "soak" and Minor abrasions and scratches will have appeared, which will result in al more accurate reading.**
- **Boats should be moored, without being operated, for at least 8 hours before performing tests. This is necessary to allow the MerCathode System and/or sacrificial anodes to polarize the surrounding water. Be careful not to rock the boat excessively while boarding to perform a test as this will alter the test reading.**

1. Plug negative meter lead into negative (–) receptacle of meter. Connect other end of lead to negative (–) battery terminal or other convenient engine ground.
2. Plug Reference Electrode Tester lead into positive (+) receptacle of meter.
3. If using Quicksilver VOA Meter 91-62562A1, set meter on "AUX TEST" position. If using a digital meter, set meter on scale required to read 0-2000 millivolts (0-2 volts).

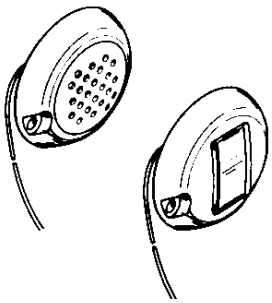
4. Immerse Electrode Tester in the water within 6 in. (150mm) of aft end of drive unit.

IMPORTANT: There will be different voltage readings depending on the type of Mer-Cathode System you are testing.



71894

Electrode Mounted on Bottom of Transom Assembly



71895

Electrodes Mounted on Boat Transom

5. The following readings indicate that sterndrive is adequately protected:

   a. **MODELS WITH ELECTRODES MOUNTED ON BOAT TRANSOM**

   Fresh Water Areas -
   7.5 - 10.5 millivolts with Quicksilver
   VOA Meter
   750 - 1050 Millivolts with Digital Meter

   Salt, Polluted or Mineral Laden Water Areas:
   8.8 - 10.5 millivolts with Quicksilver
   VOA Meter
   880 - 1050 Millivolts with Digital Meter

   b. **MODELS WITH ELECTRODE MOUNTED ON BOTTOM OF TRANSOM ASSEMBLY**

   Fresh Water Areas -
   6.2 - 11.8 Millivolts with Quicksilver
   VOA Meter
   620 - 1180 Millivolts with Digital Meter

   Salt, Polluted or Mineral Laden Water Areas:
   7.5 - 11.8 Millivolts with Quicksilver
   VOA Meter
   750 - 1180 Millivolts with Digital Meter

6. If the reading is not within specified limits, or if reading is within specifications, but there is evidence of corrosion on sterndrive, refer to the appropriate troubleshooting chart, following to aid in diagnosis.

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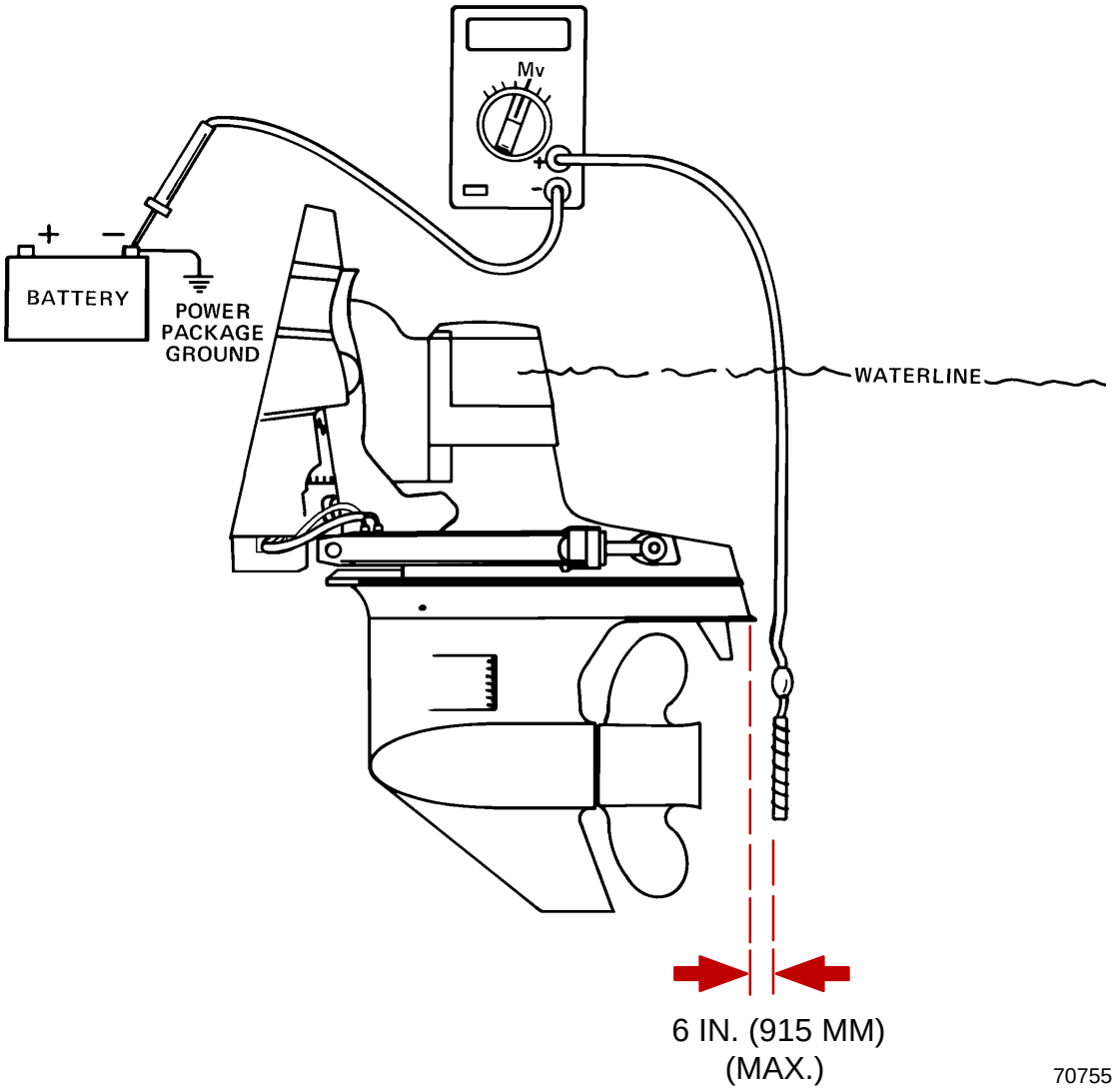
Test Equipment Set-Up



Low Readings

Cause	Remedy
1. Loss of continuity between drive unit components and negative (-) battery terminal.	1. Ensure that continuity devices are not missing or damaged and that connections are clean and tight.
2. Shore power green safety grounding lead not isolated from the power package ground (on boats equipped with shore power).	2. Disconnect shore power and notice if reading increases. If so, install a Quicksilver Isolator 76664A3 or an isolation transformer.
3. Underwater metal parts on the drive unit and/or boat are unpainted or the paint is in poor condition. The boat has more exposed metal than the anodes and/or MerCathode system can protect.	3. Prime and paint underwater metal parts. This will reduce the load on the anodes and/or MerCathode system.
4. Anodes painted.	4. Remove paint or replace anodes.
5. The anodes are improperly grounded or inactive.	5. Clean anode mounting surface or replace anodes if they have oxidized.
6. Anodes consumed (no longer protect).	6. Replace anodes if eroded 50% or more.
7. Drive unit and/or boat bottom painted with anti-fouling pant containing copper or tin.	7. Avoid any electrical interconnection between the MerCruiser product, Anodic Blocks, or MerCathode system and the paint by allowing a minimum of 1-1/2 in. (40 mm) of UNPAINTED area around these items on the transom of the boat.
8. MerCathode reference electrode or anode painted.	8. Remove paint.
9. Anodic heads used instead of plastic caps.	9. Reinstall the plastic caps.
10. No power to MerCathode controller.	10. Connect the positive (+) volt meter lead (set on 0-20 volt scale) to the positive (+) controller terminal and the negative (–) volt meter lead to the negative (–) terminal. The meter should indicate battery voltage. Check for a blown fuse (if so equipped) on the starboard MerCathode system. Clean the connection or repair wiring as required.
11. Poor connection between reference electrode lead (brown) or anode lead (orange) and MerCathode controller.	11. Clean and/or tighten the connection. Repair the wiring.

Low Readings (continued)

Cause	Remedy
12. Faulty MerCathode reference electrode.	12. Disconnect the reference electrode lead(brown) from the controller “R” terminal. Connect the lead to the positive (+) terminal of a digital multimeter (set on 0-2000 millivolt scale). Connect the negative (–) meter lead to the negative (–) battery terminal. Note the meter reading; then repeat the test using a MerCathode Reference Electrode Tester 76675A1. You should obtain the same reading in both cases. If not, replace the reference electrode.
13. Faulty MerCathode Controller.	13. With anode and reference electrode leads connected to the controller, connect the jumper wire between “R” and negative (-) terminals on the controller. Connect the positive (+) lead of the volt meter (set on 0-20 scale) to “A” terminal on the controller. Connect the negative (-) meter lead to the negative (-) controller terminal. Reading should be as follows: ● **Freshwater Areas -** Electrodes Mounted on boat transom: 7.5 - 10.5 Millivolts Electrode mounted on bottom transom assembly: 6.2 - 11.8 Millivolts ● **Saltwater Areas -** Electrodes mounted on boat transom: 8.8 - 10.5 Millivolts Electrode mounted on bottom of transom assembly: 7.5 - 11.8 Millivolts If the reading is low, replace the controller.
14. Additional corrosion protection required. Boats which are equipped with a sizable amount of underwater metal (stainless steel prop, after planes, etc.), or that are moored in an area with warm or rapid flowing water, may require additional protection.	14. Install additional anodes or MerCathode system 88334A2. If the unit is already equipped with a MerCathode system, a second system may be required.

High Reading

Cause	Remedy
1. Stray current corrosion. If an electrical current flowing along a metal conductor leaves the metal for a water path, it will cause ionization of the metal, and an area of rapid corrosion.	1. Observe the reading while disconnecting the electrical components one at a time until you eliminate the high reading. Correct the course of stray current.
2. Poor connection between MerCathode reference electrode lead (brown) and “R” terminal on controller.	2. Clean and /or tighten connection. Repair wiring as required.
3. Faulty MerCathode reference electrode.	3. Disconnect the reference electrode lead (brown) from “R” terminal on the controller. Connect the lead to the positive (+) terminal of a digital multi-meter (set on 0-2000 millivolt scale). Connect the negative (–) meter lead to the negative (–) battery terminal. Note the meter reading; then, repeat the test using MerCathode Reference Electrode Tester 76675A1. Both tools should produce the same reading. If not, replace the reference electrode.
4. Faulty MerCathode controller.	4. Replace the controller.

Normal Reading But Corrosion is Evident

CORROSION ON THE ENTIRE DRIVE UNIT

Cause	Remedy
The drive unit is raised so fare that the sacrificial anodic trim tab is out of the water.	Leave the drive unit in the “In”/“Down” position when the boat is moored to ensure the trim tab is in the water, providing protection.

CORROSION PROBLEM DEVELOPED AFTER REFINISHING THE DRIVE UNIT

Cause	Remedy
A steel wire brush was used to clean the aluminum casting. Steel particles became en-trapped and set up a small galvanic cell.	Use only a nylon or bristle brush.

PAINT BLISTERING ON DRIVE UNIT

Cause	Remedy
Battery charger, which uses 110 volt shore power, improperly connected to the battery.	Ensure the charger is connected correctly.

TRIM CYLINDER CORRODING

Cause	Remedy
Continuity lost between trim cylinder and drive unit.	Install proper continuity devices.

ONLY ONE OR TWO COMPONENTS CORRODING (BELL HOUSING, GIMBAL RING, ETC.)

Cause	Remedy
Continuity lost between drive unit and components.	If not already done, install Continuity Circuit Kit 99940A1.

CORROSION IN THE EXHAUST OUTLET AREA

Cause	Remedy
Exhaust gas deposits accumulating on the drive exterior can result in paint blistering and corrosion.	Remove deposits with marine or automotive wax.

CORROSION OCCURS AFTER THE UNIT IS REMOVED FROM THE WATER

Cause	Remedy
Salt crystals remaining on the surface of the drive components combine with high humidity to cause electrolyte formation, which results in corrosion.	Wash drive exterior and flush drive interior with fresh water.

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CORROSION BETWEEN SURFACES

Cause	Remedy
Salt buildup between surfaces.	Protect mating parts with Quicksilver Special Lubricant 101 (92-13872A1), Quicksilver 2-4-C Marine Lubricant (92-825407A2), or Perfect Seal (92-34227-1).

ALUMINUM CORRODING IN LUBRICATED AREAS

Cause	Remedy
Graphite in the lubricant.	Never use lubricants containing graphite, because they accelerate corrosion. Use specially formulated Quicksilver marine lubricants.

STAINLESS STEEL COMPONENTS CORRODING

Cause	Remedy
Foreign matter (fishing line, marine growth, etc.) covering the steel and starving it of oxygen. This causes a breakdown of the protective oxide film and subsequent corrosion (known as oxygen starvation corrosion). Burying stainless steel in sand or silt can also cause this problem.	Remove foreign matter and prevent surfaces from being covered by sand or silt.

STAINLESS STEEL PROPELLER CORRODING

Cause	Remedy
Continuity lost between propeller and propeller shaft.	Clean the mating surfaces on the propeller, propeller shaft, and attaching parts. If applicable, install a continuity washer.

PAINT BLISTERING - THE METAL UNDER THE BLISTERED PAINT IS NOT PITTED

Cause	Remedy
The surface was not properly prepared before paint was applied.	Sand the surface down to bare metal, prime and repaint with Quicksilver Spray Paint.

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ACCESSORIES

Section 8A - All Models

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8 A

Specifications

Torque Specifications

DESCRIPTION	TORQUE
Dust Cover	34 lb. in. (3.4 N·m)
Inlet Flange	112-152 lb. in. (13-17 N·m)
Valve Guide Bracket Thru Bolts	61-83 lb. in. (7-9 N·m)
End Plate to Valve Guide Bracket	112-152 lb. in. (13-17 N·m)
End Plate to Cylinder	204-276 lb. in. (23-31 N·m)

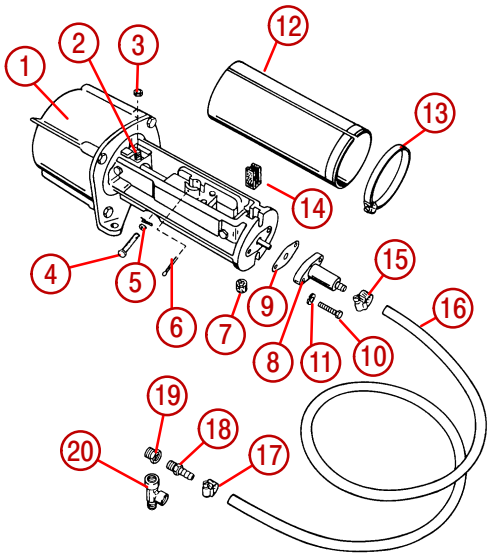
Lubricants/Sealers/Adhesives

DESCRIPTION	PART NUMBER
2-4-C Marine Lubricant with Teflon	92-825407A2

Power Shift (P/N 38638A4)

Description

The Power Shift cylinder is a vacuum actuated cylinder which assists the mechanical shifting. It utilizes the vacuum produced in the intake manifold. The vacuum is routed, by hose, to the shift cylinder.



50419

1 - Power Shift Assembly
2 - Output Cable Stud
3 - Output Cable Stud Nut
4 - Clevis Pin
5 - Input Cable Washer and Cotter Pin
6 - Cotter Pin
7 - Felt Power Shift Cylinder Plug
8 - Flange
9 - Inlet Flange Gasket
10 - Screw
11 - Lockwasher
12 - Dust Shield
13 - Clamp
14 - Spacer
15 - Vacuum Hose Clamp
16 - Vacuum Hose
17 - Vacuum Hose to Engine Fitting Clamp
18 - Vacuum Hose Fitting
19 - Vacuum Hose Fitting Reducer Bushing
20 - T-fitting (used only with vacuum gauge)

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General Information

Control Cables - Use quicksilver control cables for the input cable, output cable, and throttle cable.

ATTACHING OUTPUT SHIFT CABLE TO STERNDRIVE UNIT

Refer to the Sterndrive Unit Installation Manual or Installation Section of this manual, and follow the procedure outlined for attaching and adjusting the shift cable.

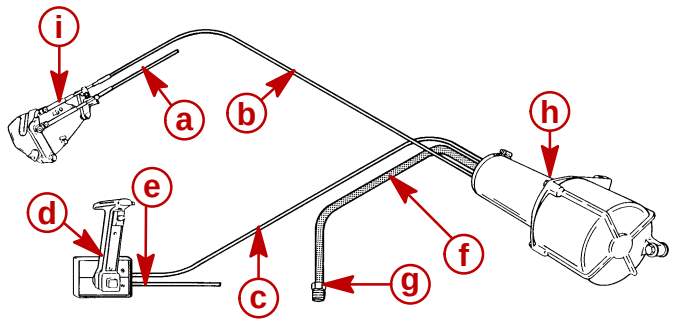
IMPORTANT:

- **Do not install the propeller before attaching and adjusting the shift cable**.
- **Do not attach the throttle cable to the carburetor before attaching and adjusting the shift cable.**
- **The engine must be running and the Power Shift operating when the cable adjustment procedure requires moving the remote control handle to the full forward or full reverse positions. After the handle has been moved, the engine may be stopped.**
- **Failure to comply with the above instructions will result in improper unit shift cable adjustment and possible damage to the sterndrive shift mechanism.**

CABLE REPLACEMENT

IMPORTANT: To ensure proper operation of the remote control and power shift, comply with the following:

- **Control cables must be correct length.**
- **Control cables should follow the shortest route from the remote control to the power shift, and from the power shift to the shift plate.**
- **Keep the bends to a minimum number and allow a bend with minimum of a 12 in. (305mm) radius.**
- **DO NOT EXCEED 6 ft. (1.8m) in length of output cable.**



50151

a - Shift Cable (To Drive Unit)
b - Output Cable (To Shift Plate)
c - Input Cable
d - Remote Control
e - Throttle Cable
f - Vacuum Hose to Engine
g - Vacuum Hose Connection at Engine
h - Power Shift Cylinder
i - Shift Plate

DETERMINING INPUT CABLE LENGTH

1. Measure the distance from the remote control (at the point where the cables leave the housing), to the power shift cylinder (at the point where the vacuum hose attaches); make the cable bends of a 12 in. (305 mm) radius or larger.
2. Select the input cable length. Use the next full foot longer cable than the measurement taken.

EXAMPLE: Measured distance = 16 ft. 3 in. (4.88 mm). Use a 17 ft. (5.18mm) cable.

DETERMINING OUTPUT CABLE LENGTH

1. Measure distance from power shift cylinder (at the point where the vacuum hose attaches), to the shift plate, following the path that the cable will travel, keeping bends to a minimum. Make bends a 12 in. (305 mm) or larger radius.
2. Select the output cable length. Use the next full foot longer cable than the measurement.

EXAMPLE: Measured distance = 16 ft. 3 in. (4.88 mm). Use a 17 ft. (5.18 mm) cable.

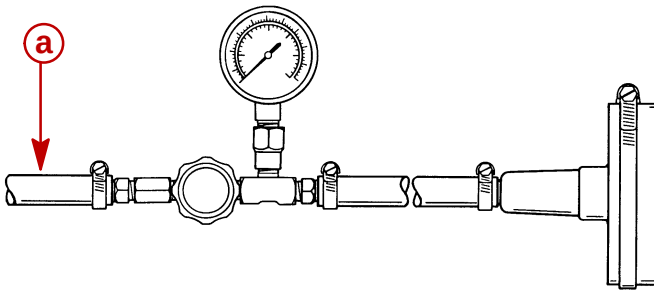
IMPORTANT: For the power shift unit to work properly, there must be a bend in the output cable. Mount the power shift cylinder at 90°-180° to the shift plate. DO NOT mount the cylinder in line with the shift plate.

IF RELOCATING THE POWER SHIFT CYLINDER

1. Select a location above the height of the intake manifold to mount the power shift cylinder in the boat. The location must not allow sharp bends in the cable. Bends must form not less than a 12 in. (305 mm) radius, and the location must place the power shift cylinder within a distance (measured along the cable path) of not less than 3 ft. (914mm) nor more than 6 ft. (1.8 mm) from the shift plate.
2. Position drilling template (90-36274) and drill holes. Temporarily mount the power shift cylinder in the selected location, reusing the lag screws (or bolts). Fill and seal the mounting holes in the former location.

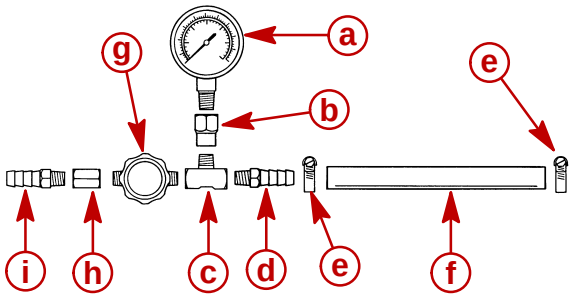
Checking Vacuum Drop-Off

1. Connect a leak proof shut-off valve and pressure gauge in-line between the Power Shift cylinder input flange and the vacuum connection at the engine manifold, with the valve toward the manifold side and the gauge toward the power shift cylinder.



50446

a - Engine Manifold to Power Shift Cylinder Vacuum Hose Disconnect at the Power Shift Cylinder



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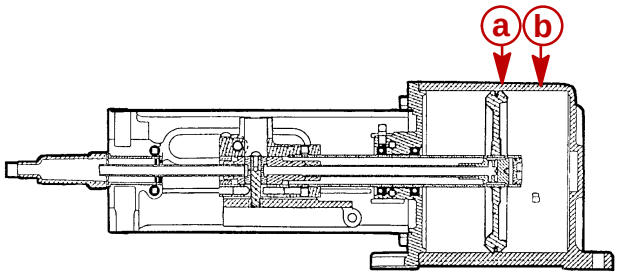
Components *

a - Vacuum Gauge
b - Coupling
c - T-fitting
d - Hose Barb Coupling
e - Hose Clamp
f - Short Vacuum Hose
g - Leak Proof Shut-off Valve
h - Coupling
i - Hose Barb

* Obtain Locally

2. With the engine running at idle, turn off the valve in the vacuum line. If the vacuum drops to “0” (zero) in less than 5 seconds, in either test, install a gasket rebuild kit.
   a. TEST1: With the cylinder piston in neutral.
   b. TEST 2: With the cylinder piston in reverse.



50422

a - Neutral
b - Reverse

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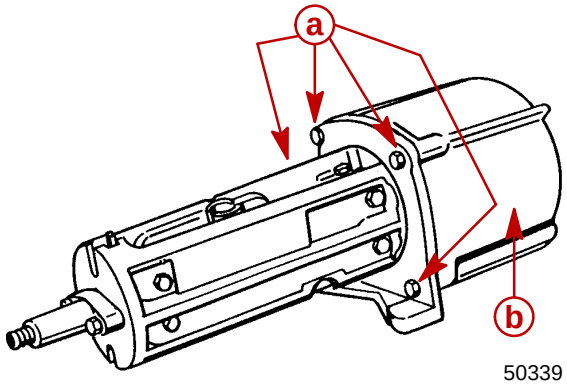
Power Shift Cylinder Repair

Removal

1. Loosen the clamps (2) and remove the dust cover from the valve guide brackets.
2. Remove the inlet hose clamp at the inlet flange, and remove the inlet hose.
3. Remove the lag screws (or bolts, if used), which anchor the cylinder to the boat.
4. Remove the cylinder from the mounting surface.

Disassembly

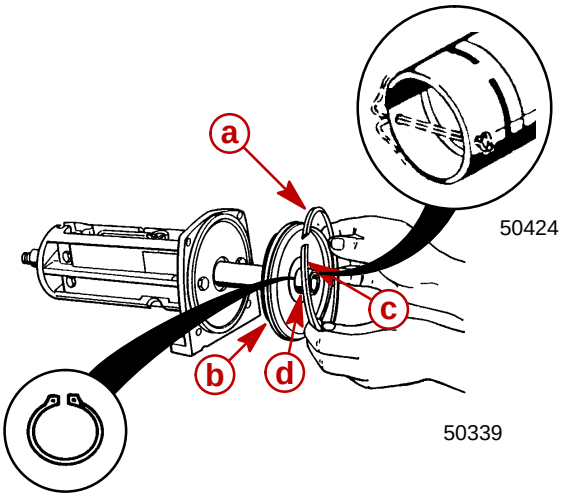
1. Remove the 4 bolts and lockwashers on the end plate. Then, remove the cylinder.



50339

a - 4 Bolts and Lockwashers
b - Cylinder

2. Remove the piston seal and O-ring from the piston (the O-ring is under the piston seal in the same groove).
3. Remove the cotter pin securing the shaft end plug. Remove the snap ring which secures the piston to the shaft.



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50424

a - Piston Seal
b - O-ring
c - Cotter Pin
d - Snap Ring

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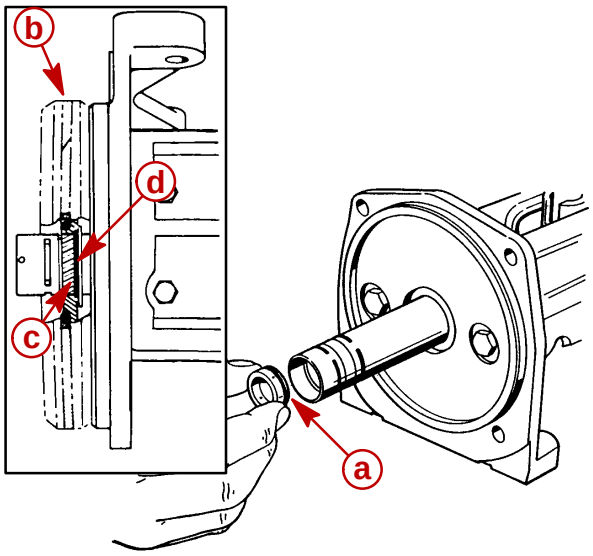
4. Remove the piston by first removing the O-ring from the shaft (behind the piston, next to the 2nd snap ring), and then removing the snap ring.
5. Remove the shaft end plug.

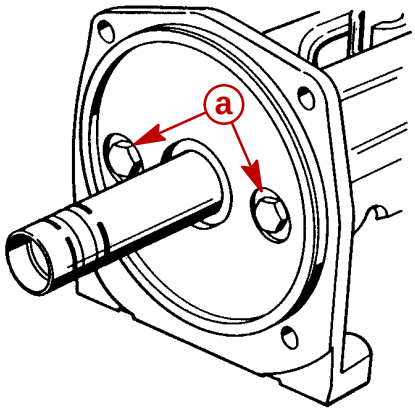


50423

50339

a - Shaft End Plug
b - Piston
c - O-ring (Behind Piston)
d - Snap Ring

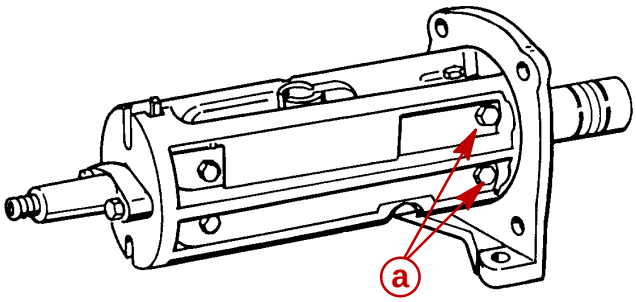
6. Remove the 2 bolts and copper sealing washers indicated below.



50339

a - 2 Bolts and Copper Washers

7. Remove the 2 thru-bolts which secure the end plate to the valve guide bracket.



50453

a - 2 Thru-bolts

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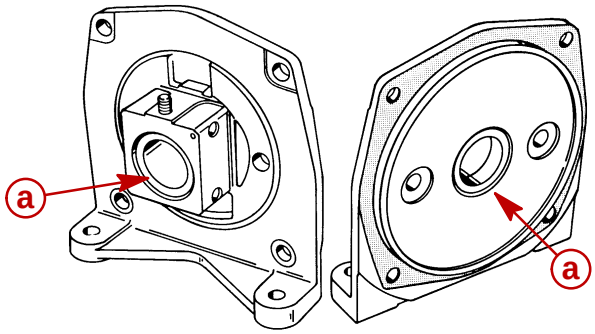
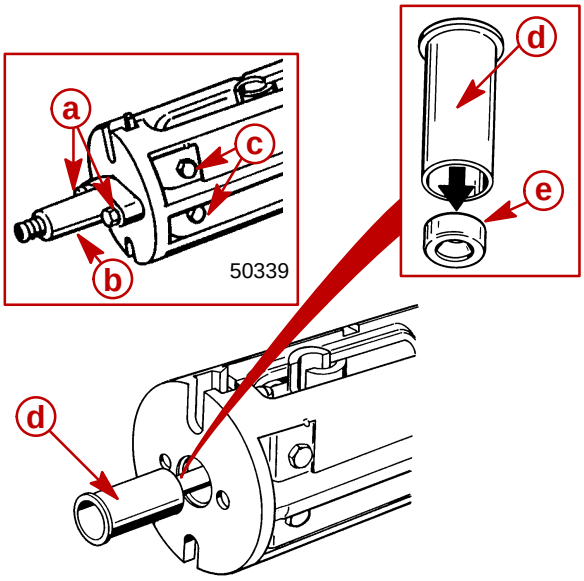
8. Slip the end plate from the valve guide bracket, and off of the shaft. It may be necessary to tap off the plate with a rawhide mallet.
9. Drive the old seals out of the end plate.



50425

a - Old Seals

10. Remove the bolts, inlet flange, and gasket. Loosen the thru-bolts and tap out the seal tube. Press or drive the old seal out of the tube.



50413

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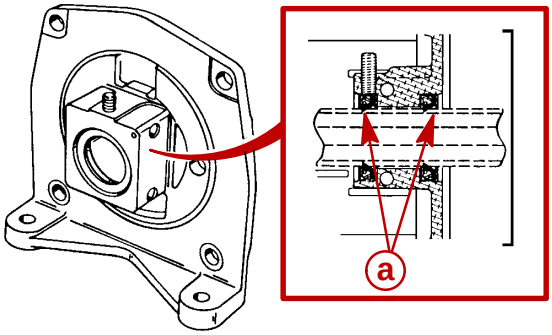
a - Bolts
b - Inlet Flange
c - Thru-bolts
d - Seal Tube
e - Old Seal

Reassembly

1. Press the new oil seals into the end plate/housing until the seals bottom out. The seal lips face in the direction shown.



50452

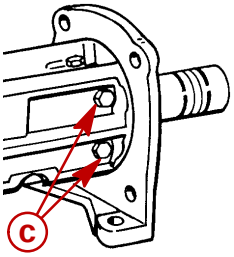
a - New Oil Seals

2. Wrap the diameter of the shaft (area “a,”) with masking tape to protect the seal lips. Generously lubricate the shaft with 2-4-C Marine Lubricant with Teflon. Lubricate the seal lips with 2-4-C Marine Lubricant with Teflon, then slide the end plate housing onto the shaft. It may be necessary to tap the housing into the valve guide bracket, to seat it fully. Remove the masking tape from the shaft end.

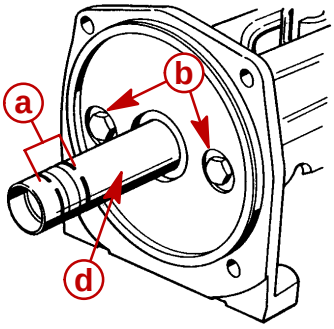
   a. Install thru-bolts, flat washers and nuts. Tighten the bolts by hand.

   b. Torque the end plate bolts and copper sealing washers to 112-152 lb. in. (13-17 N·m).

   c. Torque the thru-bolts to 61-83 lb. in. (7-9 N·m).



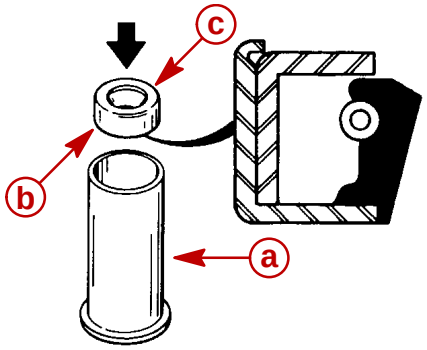
50453



50339

a - Put Masking Tape Over Shaft Diameter (Area “a”)
b - End Plate Bolts
c - Thru-bolts
d - Drive Shaft

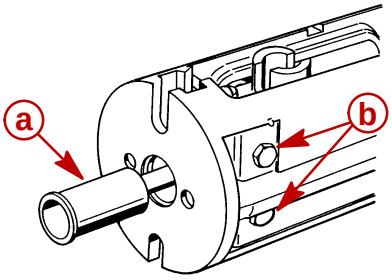
3. Press a new seal, lip facing out, into the seal tube, so that the seal is flush with the end of the tube. Lubricate the I.D. of the seal with 2-4-C Marine Lubricant with Teflon.



50452

a - Seal Tube
b - New Seal
c - Lip

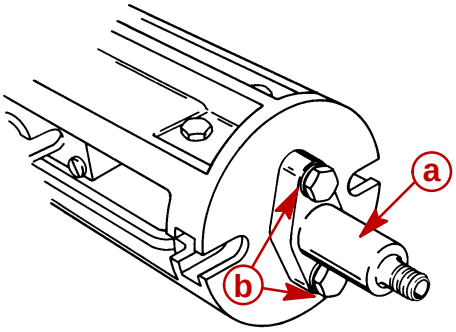
4. Place masking tape over the shaft end to protect the sea. Lubricate the shaft with 2-4-C Marine Lubricant with Teflon. Slide the seal tube (with the seal installed) onto the shaft and slide the seal tube into the valve guide bracket. While holding the seal tube firmly in the seated position in the valve guide bracket, tighten the thru-bolts. Torque the thru-bolts to 61-83 lb. in. (7-9 N·m). Remove the masking tape from the shaft end.



50339

a - Seal Tube
b - Thru-bolts

5. Install the inlet flange (a) along with a new gasket. Secure the flange and gasket with two bolts and lockwashers. Torque the bolts to 112-152 lb. in. (13-17 N·m).



50421

a - Inlet Flange
b - Two Bolts and Lockwashers

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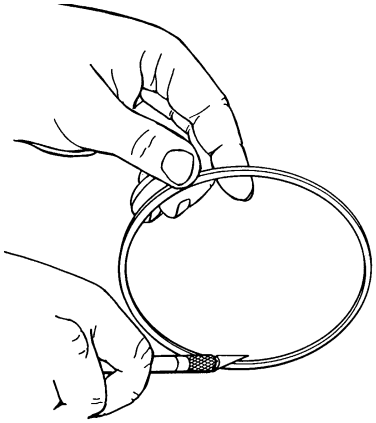
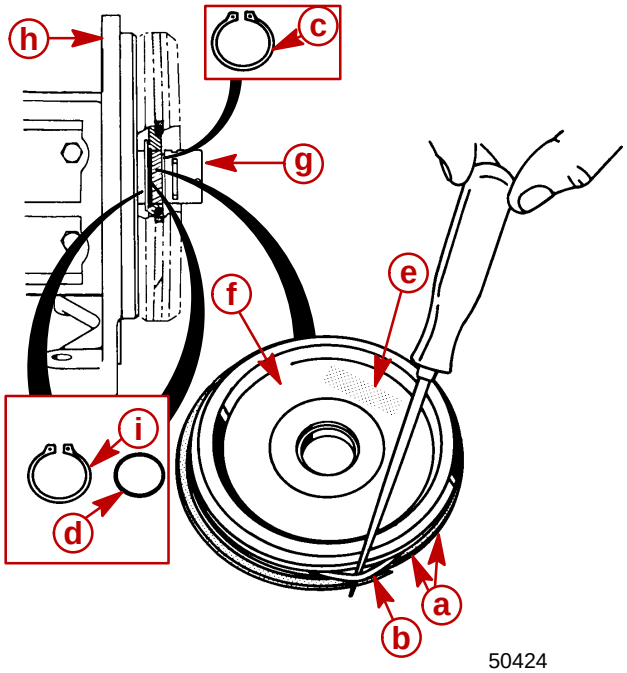
6. If the piston seal is not pre-cut, make a diagonal cut/separation as shown.

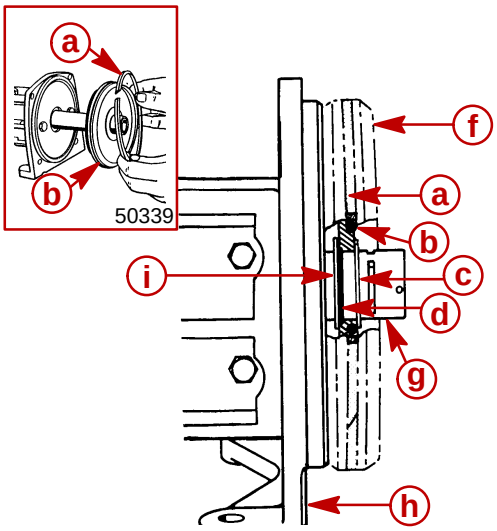


50339

7. Install the O-ring in the O.D. groove in the piston. Install the piston seal over the O-ring.
8. Install the snap ring on the shaft. Make sure the snap ring is fully seated in its groove. Install the O-ring onto the shaft. Slide the O-ring down to the snap ring.
9. Slide the piston onto the shaft. Secure the piston with a snap ring. Make sure the snap ring is fully seated in its groove.



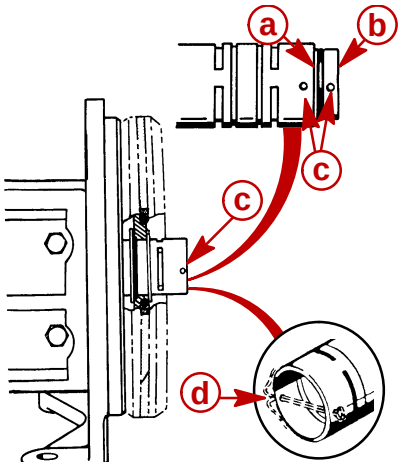
50424



50423

a - Piston Seal
b - O-ring (Under Piston Seal)
c - Snap Ring (Outer)
d - O-ring (On Shaft)
e - Casting Number (This Side “In”, Toward The End Plate)
f - Piston
g - Shaft
h - End Plate/Housing
i - Snap Ring (Inner)

10. Install a new O-ring onto the shaft end plug. Lightly lubricate the O-ring with 2-4-C Marine Lubricant with Teflon, then insert the plug into the shaft end. Be careful not to damage the O-ring. A damaged O-ring will cause a vacuum leak. Align the cotter pin holes and secure the end plug to the shaft with a cotter pin. Spread both ends of the cotter pin.



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50423

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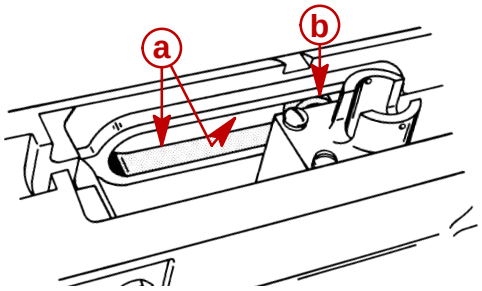
a - O-ring
b - Shaft End Cap
c - Cotter Hole(s)
d - Cotter Pin Ends

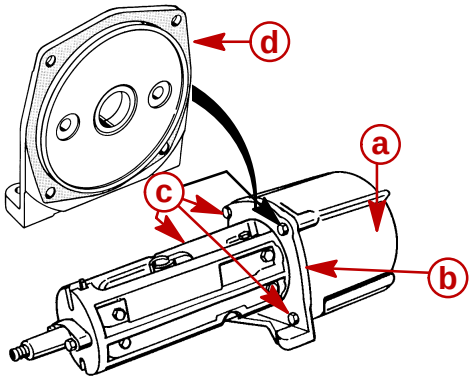
11. Liberally apply 2-4-C Marine Lubricant with Teflon to each side of the slide rails and wheel.



50426

a - Slide Rails
b - Wheel

12. Install a paper gasket onto the end plate. Hold the gasket in place with 2-4-C Marine Lubricant with Teflon. Then, attach the cylinder to the end plate with 4 bolts and lock washers. Torque the bolts to 204-276 lb. in. (23-31 N·m).



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a - Cylinder
b - End Plate
c - 4 Bolts and Lockwashers
d - Paper Gasket

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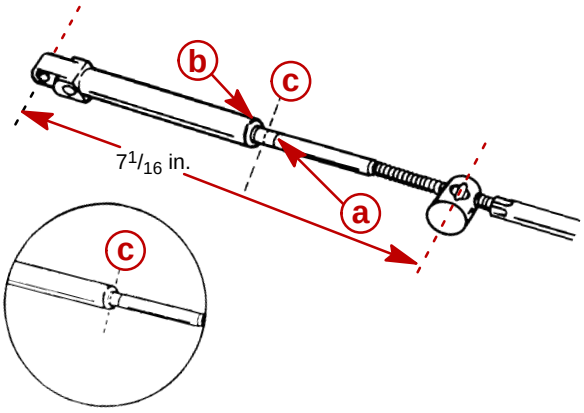
Shift Cable Replacement and Adjustment

Installation Preparation

If installing a new shift cable(s), complete the hookup to the remote control and route the shift cable(s) before starting the following procedures.

Shift Cable Barrel Adjustment

1. Shift the remote control into neutral.
2. Push in on the input shift cable end guide with enough pressure to remove free-play and mark position “a” on the tube.
3. Pull out on the input shift cable end guide with enough pressure to remove free-play and mark position “b”.
4. Measure the distance between marks “a” and “b”, then mark position “c” halfway between them. Position “c” marks the center of free-play.
5. Position the cable end guide at the center of free-play (position “c”).
6. Adjust the barrel so that the distance between the centerline of the cable end guide mounting hole, and the centerline of the cable barrel hole is $7^{1}/_{16}$ in. (179mm) apart (with the end guide in position “c”).

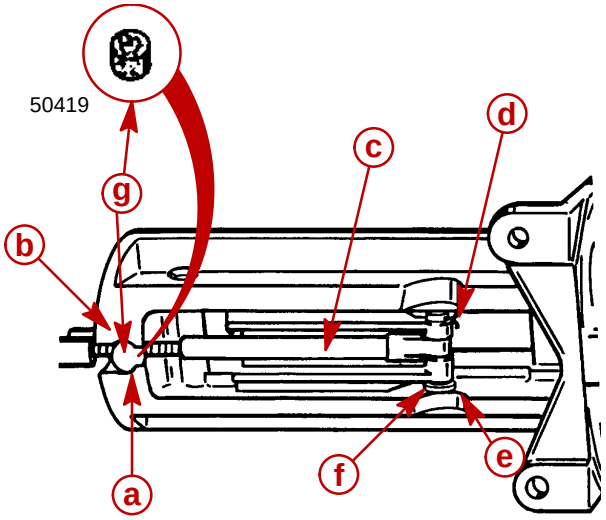


22024

a - Position “a”
b - Position “b”
c - Position “c”

Installing Input Cable

1. Install the input cable as shown. Take care not to change the position of the barrel.
2. Place a round felt plug in the valve guide bracket hole on top of the cable barrel.



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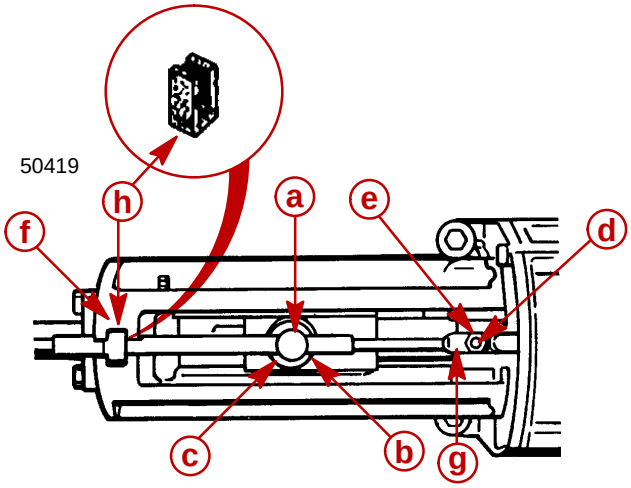
a - Input Cable Barrel
b - Valve Guide Bracket
c - Cable End Guide
d - Cotter Pin
e - Clevis Pin
f - Input Cable Bracket
g - Round Felt Plug

Installing Output Cable

1. Install output cable as shown.
2. Place a rectangular felt spacer in the recess of the valve guide bracket.



50176

a - Output Cable Barrel
b - Cotter Pin
c - Yoke
d - Threaded Stud
e - Nut
f - Valve Guide Bracket
g - Output Cable End
h - Rectangular Felt Spacer

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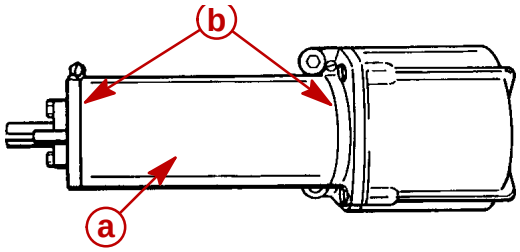
Attach Dust Cover

1. Place the dust cover in to position as shown. The slot in the cover should be on bottom when the power shift cylinder is mounted to the boat.
2. Place clamps around each end of the cover. Tighten securely.



50151

a - Dust Cover
b - Clamps

NOTE: *For shift cable adjustment, refer to Section 2A of this manual.*

Mounting Power Shift Cylinder

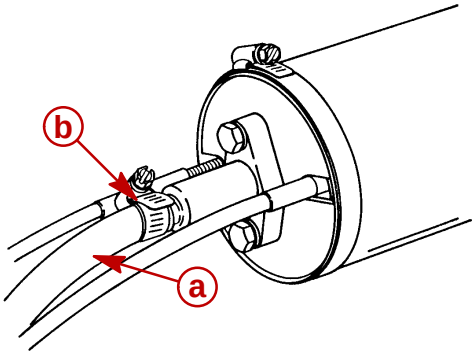
1. Securely fasten the power shift cylinder to the boat with lag screws (or bolts).
2. Fasten the input cable to the boat. Do not fasten the cable within 18 in. (457mm) of the power shift cylinder.

IMPORTANT: Do not secure the output cable to the boat or any other cable or hose. The outer conduit of the cable must be free to move back and forth when the unit is shifted.

Connecting Vacuum Hose to Engine

IMPORTANT: Keep the vacuum hose in as straight an incline, from the cylinder to the engine hose fitting, as possible. Avoid a sag (low spot) in the hose.

1. Connect the vacuum hose to power shift cylinder, as shown.
2. Securely tighten the hose clamp.

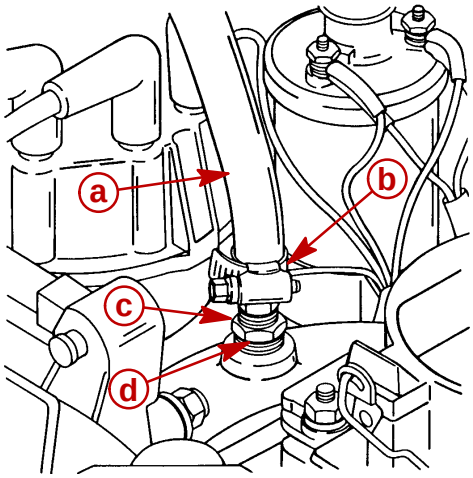


50152

a - Vacuum Hose
b - Hose Clamp

3. If replacing the vacuum hose, cut the hose to the length required.

4. Place the hose clamp over the end of the hose and slide the hose over the fitting. Tighten the hose clamp securely.



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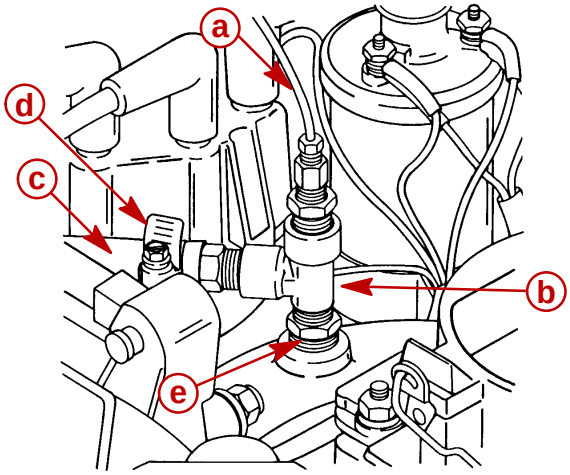
Engine WITHOUT Vacuum Gauge Installed

a - Vacuum Hose
b - Hose Clamp
c - Hose Connector Fitting
d - Reducer Fitting



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Engine WITH Vacuum Gauge Installed

a - Vacuum Gauge Line (To Instrument Panel)
b - T-fitting
c - Vacuum Hose (From Power Shift Cylinder)
d - Hose Clamp
e - Reducer Fitting

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